

**THE CHICAGO ACADEMY OF SCIENCES**

**THE MOLLUSCA OF THE CHICAGO AREA**

**THE PELECYPODA**

BY

FRANK COLLINS BAKER

CURATOR OF THE CHICAGO ACADEMY OF SCIENCES

**BULLETIN No. III.**

**PART I.**

OF

**THE NATURAL HISTORY SURVEY**

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## LETTER OF TRANSMITTAL.

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CHICAGO, ILLINOIS, June 1, 1898.

DEAR SIR:

By direction of the Board of Managers of The Natural History Survey of The Chicago Academy of Sciences, I herewith submit to you for publication, as Part I. of Bulletin No. III. of the Survey, the report on The Molluscs of the Chicago Area, prepared by Frank Collins Baker, Curator of The Chicago Academy of Sciences, to be issued under the rules of the Academy governing such matters.

Respectfully,

WILLIAM K. HIGLEY,  
Chairman.

THOMAS C. CHAMBERLIN,

President of The Chicago Academy of Sciences.



The Board of Managers of The Natural History Survey of The  
Chicago Academy of Sciences:

WILLIAM K. HIGLEY, Chairman.

CHARLES S. RADDIN, Secretary.

THOMAS C. CHAMBERLIN.

GAYTON A. DOUGLASS.

THOMAS T. JOHNSTON.

## THE NATURAL HISTORY SURVEY.

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The Mollusca, the title of Bulletin Number III. of The Natural History Survey, will be issued in two parts. The subject of the present report is the Pelecypoda, and a later publication will treat of the Gastropods.

The work has been prepared by Mr. Frank Collins Baker, Curator of The Chicago Academy of Sciences, who has not only illustrated all species described, by half tones or zinc etchings made from original photographs and drawings, but has also placed in the collection of the Academy a large number of specimens showing the development of and variations in each species found in the area covered by the Survey.

The territory embraced by the publications of the Survey includes Cook and DuPage Counties and the nine north townships of Will County in Illinois, and a portion of Lake County, Indiana. This area gives a surface of about forty-eight or fifty miles square, or a land surface of nearly 1,800 square miles.

All species have been described and keys prepared, in order that the work may be used as a text-book for the local forms of the Mollusca, thus making the subject available to many students who are deterred from pursuing the study because of the high price and rarity of most of the text-books on this subject.

For the reason that Part II. will soon be issued, it has been thought best to withhold the bibliography, glossary and index until the second part is published, and to then make them complete for both parts. It was found that in making the plates, illustrations of three species of *Pisidium* had been included with a number of gastropods, hence this plate has been reserved for Part II., and the references to it have been made accordingly.

The Board of Managers of the Survey takes pleasure in acknowledging its obligation to Mr. Charles T. Simpson, of the Smithsonian Institution, who not only examined the manuscript of the bulletin, making many valuable suggestions, but reviewed the family Unionidæ and added original matter of his own which is here published for the first time. The board also wishes to express its appreciation of the valuable suggestions

that have been made by various conchologists throughout the country, acknowledgment of which has been made by Mr. Baker in the text.

A most attractive feature of the publication is the excellent work done on the photographs, which was made possible by the use of a very valuable camera furnished by Messrs. John Wilkinson and Son, and the skillful work of Mr. Thomas J. Staley, who photographed the shells and developed the negatives.

Finally, it is again a pleasure to make mention of the patrons of The Natural History Survey, whose generosity has tended so much to its success and to make recognition of the arduous labors of Mr. Baker, which have made it possible to issue a work which is most creditable to himself and enables the Survey to make another contribution to the advancement of science.

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## ERRATA.

In the generic descriptions of the Unionidæ Mr. Simpson has described both shell and animal. This statement is made in view of the fact that on page 50 Mr. Simpson's name is placed after both shell and animal descriptions, and follows only that of the animal in the descriptions of the other genera.

Page 11, third line, for Glenn read Glen.

Page 17, eighteenth line, for oarolinensis read carolinensis.

Page 17, thirty-sixth line, omit *Quadrula pustulata* (not found in our area).

Page 18, tenth line, for *Quadrula parva* read *Lampsilis parvus*.

Page 18, et al, in place of *Elimia* use *Goniobasis*. (See Part II.)

Page 22, No. 117, for *complanatus* read *campanulatus*.

Page 23, twenty-seventh line, for *decisium* read *decisum*.

Page 23, forty-third line, for *albolabris* read *thyroides*.

Page 26, ninth line, for *Vitræ* read *Vitreæ*.

Page 28, fifteenth line, for *Anadonta* read *Anodonta*.

Page 33, footnote, for Witmerstone read Witmer Stone.

Page 35, No. 24, for *Lymnæa* read *Limnæa*.

Page 44, twenty-second line, insert a comma after the word elongated.

Page 44, thirty-fifth line, insert a comma after the word small.

Page 46, last line, for Part I., 1890, read Part III , 1895.

Page 47, fifteenth line, for *radiacal* read *radial*.

Page 62, twenty-first line, for fig. 4 read fig. 3.

Page 62, twenty-second line, for *Anadonta* read *Anodonta*.

Page 64, twenty-ninth line, for U. read A.

Page 67, ninth line, for pl. xii., read pl. vii.

Page 69, last line, add (Simpson).

Page 73, twenty-fifth line, for *branchiæ* read branch

Page 73, last line, for *pressus*, read *pressa*.

Page 100, for Section *Euryma* read *Eurynia*.

Page 103, thirteenth line, omit reference to pl. xxvii (= *Anodonta grandis*).

Page 109, for Section *Corunculina* read *Carunculina*.

Page 111, thirty-first line, add the word " as" after the word laterals.

Page 116, nineteenth line, for *Sarratogea*, read *sarratogea*.

Page 120, twenty-seventh line, for *sphærium*, read *Sphærium*.

Explanation of Plate VII., for *Alasmodonta edentula* read *Strophitus edentulus*.

Explanation of Plate XIX., No. 3, for *coccina*, read *coccinea*.

Explanation of Plate XX., *Obliquaria cornuta* Barnes, read *Obliquaria reflexa* Raf.

Explanation of Plate XXVII., No. 8, for *Sinsley*, read *Linsley*.

## INTRODUCTION.

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The present volume includes a monographic, illustrated account of all the species of mollusks\* which have been collected by various conchologists in the region covered by The Natural History Survey of The Chicago Academy of Sciences. More information regarding the animal, radula, some parts of the anatomy, and habits of the species has been introduced than is generally included in reports of this kind, but it is believed that a work of this nature will be found more useful to those studying this interesting branch of zoölogy. The halftones are, except when otherwise mentioned, from photographs of the shells made by Mr. Thomas J. Staley, Jr., Assistant to the Curator, and it is hoped that the number of figures given of each species will greatly aid beginners in identifying their collections. A bibliography and a glossary are added.

In the preparation of this work about 20,000 specimens have been examined and several questions of synonymy have been critically surveyed and a satisfactory decision reached, though it is quite probable that many conchologists will not agree with the arrangement of some species, or with the synonymy adopted. In many cases specific limits have been totally misunderstood and sexual and local characters have been adopted as specific. The writer believes, with Mr. Pilsbry, that a species is any form of animal or plant that is not connected with any other *living* animal or plant by intermediate stages. It does not matter how small the character which separates the two forms so long as it is constant. A variety may be considered as simply a modification which is more or less connected by living intermediate forms. The line between a species and a variety, or subspecies is, however, very flexible, and hardly two authors agree as to just what characters shall constitute one or the other.

The keys used in this report apply only to the species as they are found in the area under consideration, although in many cases they will apply equally as well to the same species found in other localities. The measurements of the shells and animals

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\*It is probable that a number of species will be added to this list in time, although the area has been very carefully and systematically examined during the past ten years.

are in millimeters and the numerals following the former are the accession numbers of the specimens in the museum of The Chicago Academy of Sciences. In the description of the species, the diagnosis of the shell and animal refers only to specimens found in this area. Distribution and geological distribution signify their dispersal throughout time and space, outside of as well as within our territory. Habitat refers only to the area covered by this report.

The following collections have been examined in preparing these pages: Mr. J. H. Ferriss, Joliet; Mr. T. Jensen, Chicago; Prof. W. K. Higley, Chicago; and the local collection of The Chicago Academy of Sciences, which numbers about 4,000 specimens, representing almost every prominent locality in the area. The writer has personally collected in all parts of the territory, and very few notes of station or locality have been accepted until personally examined. The writings of Messrs. Call, Prime, Pilsbry, Simpson, Tryon, Haldeman, Stimpson, etc., have been freely used for information, and the source of such information has been indicated in the text.

The writer wishes especially to acknowledge his indebtedness to the following persons, who have given him very much valuable assistance and advice:

Prof. Henry A. Pilsbry, Conservator, Conchological Section, Academy of Natural Sciences, of Philadelphia, Penn., who has identified the *Amnicolæ*, *Ancyli*, etc.; Mr. Charles T. Simpson, Department of Mollusks, United States National Museum, Washington, D. C., who has revised the *Unionidæ*, identifying many of them as well as a number of gastropod mollusks; Prof. R. Ellsworth Call, Superintendent of Schools, Lawrenceburg, Ind., who has identified many of the *Unionidæ* and all the *Camelomæ*; Dr. V. Sterki, New Philadelphia, Ohio, who has examined the *Pupæ*, *Sphæria* and *Pisidia*, and given valuable notes on their classification. The following persons have also very materially assisted, either by notes, advice or specimens: Mr. Charles W. Johnson, Curator, Wagner Free Institute of Science, Philadelphia, Penn.; Dr. W. S. Strode, Lewistown, Ill.; Mr. Witmer Stone, Conservator, Ornithological Section, Academy of Natural Sciences, of Philadelphia; Messrs. J. H. Ferriss and J. H. Handwerk, Joliet, Ill.; Mr. Paul Bartoch, United States National Museum, Washington, D. C.; Prof. W. K. Higley, Messrs. Frank M. Woodruff, T. Jensen, Paul Favour, Otto Spiedel, C. S. Raddin, C. M. Higginson, W. W. Calkins, Carl

Dilg, Dr. Howard N. Lyon, Miss Grace M. Hall, Mrs. Agnes Chase and Mrs. Lillian M. Baker, Chicago; Mr. B. T. Gault, Glenn Ellyn, Ill.; Prof. Oliver Marcy, Northwestern University, Evanston, Ill.; Mr. Eliot Blackwelder, Morgan Park, Ill., and Mr. Edward H. Baker, of Providence, R. I.

The author's thanks are also due to Messrs. Arthur and John Wilkinson for the use of a valuable camera, with which the plates in this volume were made, and the authorities of the United States National Museum, who kindly opened the way for the examination of a large quantity of material from the collection of The Chicago Academy of Sciences.

## I. GENERAL CHARACTERS OF THE MOLLUSCA.

It is very difficult to prepare an exact definition of the Mollusca. That generally given — laterally symmetrical, unjointed body protected by a shell and with a creeping disk, etc. — is hardly correct, since in the majority of forms the lateral symmetry is effaced by torsion (snails) and by attached forms (oyster). The writer would define a mollusk as a body composed of cells which form a double sac, the outer being the body wall and the inner the covering of the digestive tract, the space between these two sacs being a coelum or blood lymph space. The body is differentiated into a head (prostomium) and a dorsal and ventral surface and right and left sides, thus giving rise, in the more primitive forms, to bilateral symmetry. In all forms there is a creeping disk or foot, which is really the most characteristic part of this group. A pallium or mantle is always present, which secretes, in the shelled forms, the calcareous exoskeleton or shell. The gills (ctenidia) are developments from the body-wall and contain two blood vessels. The nervous system consists of paired ganglia or nerve masses which are more developed about the head than in any other region, and which send off other ganglia with connecting commissures to other parts of the body. The circulatory system consists of a ventricle and one or two auricles, situated within a pericardium. Paired or single nephridia (renal organs) are present, and a more or less complicated reproductive system, which is in many cases hermaphroditic. In one group (Gastropoda) the mouth is provided with a manducatory apparatus (odontophore, radula or tooth bearer).\*

\*For an excellent account of the Mollusca, see Lankester, Zoological Articles, p. 95, to which the author would acknowledge his indebtedness for much information.



The subkingdom Mollusca is placed by most authors between the worms (Vermes) and the crustaceans and insects (Arthropods). By some it is considered an offshoot of the worms, and there is, in some respects, a strong similarity in the developmental history of the two subkingdoms. The group is somewhat related to the Vertebrata through the Cephalopoda, where the brain is protected by a cartilaginous covering and the eye is developed to a wonderful degree. The subkingdom is of quite recent date geologically, not appearing in any numbers until the Silurian period. From that time to the present they have greatly increased in numbers; there are at present known about 50,000 living and the same number of fossil species.

## II. TOPOGRAPHY OF THE AREA.\*

The area in question is one of great interest to the malacologist, since it has been very little written upon and almost nothing is known concerning the extent of its molluscan fauna. The area included is embraced in two drainage systems, one draining into Lake Michigan through the lakes in the southern part of the region and the Chicago River, and one into the Mississippi River through the Desplaines, DuPage, Fox and Illinois rivers. The area includes all of Cook and DuPage counties, the nine northernmost townships of Will County, Illinois, and a small portion of the western part of Lake County, Indiana. The land and water area comprises about twenty-five hundred square miles, or eighteen hundred square miles of land surface. A remarkably low divide runs north and south between the north branch of the Chicago River and the Desplaines River, which at its lowest level is scarcely more than twelve feet above Lake Michigan. It is so low, in fact, that many times during high water the surface water from the Desplaines overflows its banks and runs into Lake Michigan through the north branch of the Chicago River. In this manner numerous species found in the Desplaines River are also found in the small ponds and creeks between it and the lake.

In the southern portion of the region there are five small lakes, lying partly in Cook County, Illinois, and partly in Lake County, Indiana. These are the Calumet ( $3\frac{1}{2} \times 1\frac{1}{2}$  miles), George ( $2\frac{1}{2} \times \frac{5}{16}$  miles), Wolf ( $3 \times 1\frac{1}{2}$  miles), Berry ( $2 \times \frac{1}{8}$  miles)

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\*For an extended account of the geology and topography of the area, see "The Flora of Cook County, Illinois, and a Part of Lake County, Indiana," by Messrs. Higley and Raddin, and "The Pleistocene Features and Deposits of the Chicago Area," by Frank Leverett.

and Hyde ( $1\frac{3}{4} \times \frac{3}{8}$  miles). The lakes are all connected with each other and with Lake Michigan by sluggish bayous and the Calumet River. The entire southeastern region is drained by the Grand Calumet and Little Calumet rivers into Lake Michigan. The northern part of the area is drained into Lake Michigan by the branches of the Chicago River, and the central and western portion is drained into the Illinois River, and finally into the Mississippi by the Desplaines River and its small branches, and the DuPage River with east and west branches, which empties into the Desplaines in the western part of Will County. In the northwestern portion of Cook County there are several small streams which drain into Fox River. Most of the area outside the lake basin has a black prairie soil and the streams are bordered by more or less dense woodlands. "Within the lake basin there is a clay surface upon which are sand and gravel ridges covered with oaks, and between which are swamps and beds of peat." (Higley & Raddin.)

### III. LOCALITIES OF SPECIAL INTEREST.

There are a number of particularly interesting localities in the area, of which the following are the most important:

**MORGAN PARK.** Just west of Morgan Park, in the township of Worth, lie a number of sloughs and small ponds in which a variety of species of mollusks abound. The soil here is of a black, clayey loam, from ankle to knee deep. The water in the ponds in summer is from knee to waist deep. The whole country in this region is rolling, the ridges being separated by slough covered prairies. During the spring, when floods occur, the region is converted into a miniature sea. Numerous species of birds gather here to feed upon the mollusks, and the locality is one equally as well suited for the ornithologist as for the conchologist. The drainage is into the Little Calumet River and thence to Lake Michigan.

**MAYWOOD.**—This locality is situated ten\* miles west of Chicago, in Proviso Township, on the Desplaines River. The banks here are from two to fifteen feet in height, and well wooded. The soil consists of a clayey loam, which is covered with dead leaves and sticks. The river is very turbid, the water being contaminated by the sewage which is discharged into the river at several points in the vicinity. West of Maywood

\*These distances are reckoned from the city hall, in the center of the business district of the city.

the country is a vast prairie upon which no mollusks are to be found. The whole length of the Desplaines River is good territory for this class of animals.

**BOWMANVILLE.**--This is one of the best localities in the entire area. It is situated seven miles northwest of Chicago near the north branch of the Chicago River in Jefferson Township. The region is well wooded with a forest of large trees, and the ground is strewn with dead leaves and fallen logs and sticks. The forest occupies two hillsides sloping to meet a small stream, which empties into the north branch of the Chicago River. An old wooden bridge which crosses this stream is the best single locality. No less than ten species have been collected beneath this bridge within a radius of eight feet. The soil in the woods at this locality is moist and generally covered with a thick mould in which the mollusks love to bury themselves. Twenty-five species have been recorded from this very prolific habitat and more will probably be found when the ground is more carefully explored.

**WOLF, HYDE, CALUMET, GEORGE AND BERRY LAKES.**--This chain of lakes lies partly in Lake County, Ind., and partly in Cook County, Ill., principally in Hyde Park Township. They are from twelve to eighteen miles from Chicago in a southeasterly direction. The shores about these lakes are generally bare of woodlands, although a small patch of woods occurs here and there which yields an abundant supply of mollusks. These woodlands are moist and, as usual, carpeted with a layer of mould covered with logs. The shores of the lakes are sandy or muddy and are shallow; in fact one may wade across them in many places. The northern portions of these lakes are the best for collecting purposes. At Roby there is a little ditch by the electric car line in which a number of species of Limnæids flourish.

Of the lakes just mentioned, Berry is now thoroughly spoiled as a collecting locality on account of the Standard Oil Works, and by being partly filled up and drained. The timber has also been cut from its shores. This last statement is also true of Hyde and George lakes, the different railroads making embankments through them and cutting the lakes into ditches. Wolf and Calumet lakes are now the only bodies of water left in which good collecting may be done.

**JOLIET.**-- This very prolific locality is situated thirty-three miles from Chicago, on the Desplaines River, in Joliet Township,

Will County. Numerous small streams empty into the Desplaines in this vicinity and afford excellent localities for moluscan life. The river bottom land is low and swampy, but outside of this the ground is higher and supports a good forest of large trees, affording protection to many species of land snails. The bed of the streams and creeks is composed of a soft, black mud, very conducive to the growth and perfection of mud-loving species, such as *Unio* and *Sphærium*. All of the species found here are exceptionally large and fine, owing probably to the large quantity of limestone in the vicinity. The drainage is into the Illinois River via the Desplaines River.

LIVERPOOL, IND.--This interesting locality is situated twenty-seven miles from Chicago, near Deep River, in Lake County, Indiana. The drainage is into Lake Michigan through the Little and Grand Calumet rivers. The upper part of Deep River sometimes drains into the Desplaines drainage in times of particularly high water. The Little Calumet River runs through low swamps and meadowland, where there is an abundance of black loam and mud. To the east, near Tolleston, there are numerous sand hills on high ground, and to the west an abundance of tall timber on high land. The ground is covered with a rich mould, very conducive to the growth of *Helices*. Deep and Little Calumet rivers have a muddy bottom and the water is quite deep. *Unios* (*rectus*, *undulatus*, *luteolus*, etc.) are found here in great abundance and of large size and fine development. *Limnæids*, *Physæ* and other fresh water shells thrive abundantly.

LISLE.-- This locality is about a mile north of the town of Lisle and lies partly in Lisle and partly in Milton townships. It is twenty-three miles from Chicago. The drainage is by the east branch of the DuPage River into the Desplaines River. The soil is a black loam and the bed of the river is covered with a slimy, black mud. The region is not well wooded. Fresh water mollusks are very abundant.

EVANSTON BIG WOODS.-- This locality is situated three miles west of North Evanston and thirteen miles north of Chicago. This is the largest patch of woodland in the area, and is noted for its good collecting. The ground in the spring is flooded, making small lakes here and there which abound in mollusks, particularly the genus *Sphærium*. The ground is carpeted with a heavy mould and is strewn with fallen tree trunks and branches. Nettles also abound and are much sought after by the land shells as food. About two miles east of the

woods there is a small stream in which a great diversity of *Physæ* may be found.

**CALUMET RIVER.**-- This river runs through Lake County, Indiana, and Thornton and Hyde Park townships, Cook County, Illinois, in a north and westerly direction and empties into Lake Michigan. The only portion in which collections have been made is that part lying in Hyde Park Township. It is from eleven to fifteen miles from Chicago. The banks are muddy and at the present time are denuded of woodlands. The water is of considerable depth, but along the shores there are shallows in which mollusks are numerous.

Other good points which may be mentioned are Avondale, Edgebrook, Blue Island, Riverdale, the south branch of the Chicago River, Riverside, Dunning, Lemont, Hickory Creek, Rock Run, the Illinois and Michigan Canal, Naperville, Lockport, Willow Springs, Romeo, Salt Creek and Thorn Creek.

In several parts of the area under discussion the natural drainage has been much affected by artificial canals; in the southern region the old canal feeder connects the Desplaines River with Stony Creek, which causes the waters of the Little Calumet River to mingle with those of the Desplaines River. In the middle of the area the waters of the Illinois and Michigan Canal and the south branch of the Chicago River mingle with the waters of the Desplaines River and Lake Michigan. These facts probably account to some extent for the similarity of the Mississippi Valley and Great Lake faunæ.

#### IV. GEOGRAPHICAL DISTRIBUTION.

The geographical distribution of the species within the area is interesting. The present lakes and ponds of large size are the relics of the glacial period and were once included in the area of Lake Michigan, or Lake Chicago, as it is called geologically (Fig. 1). The receding of the lake has left a peculiar distribution of the molluscan fauna, especially the land snails. Thus we find that there are certain species found in the northern part of the area which are not found in the southern part, and vice versa. *Polygyra albolabris*, *P. tridentata*, *Pyramidula solitaria* and *Pupa fallax* are not found in the northern region, but are abundant in the southern region. So also with *Planorbis campanulatus* and *P. bicarinatus* which are abundant south, but so far as known, absent north. The *Unios* are all

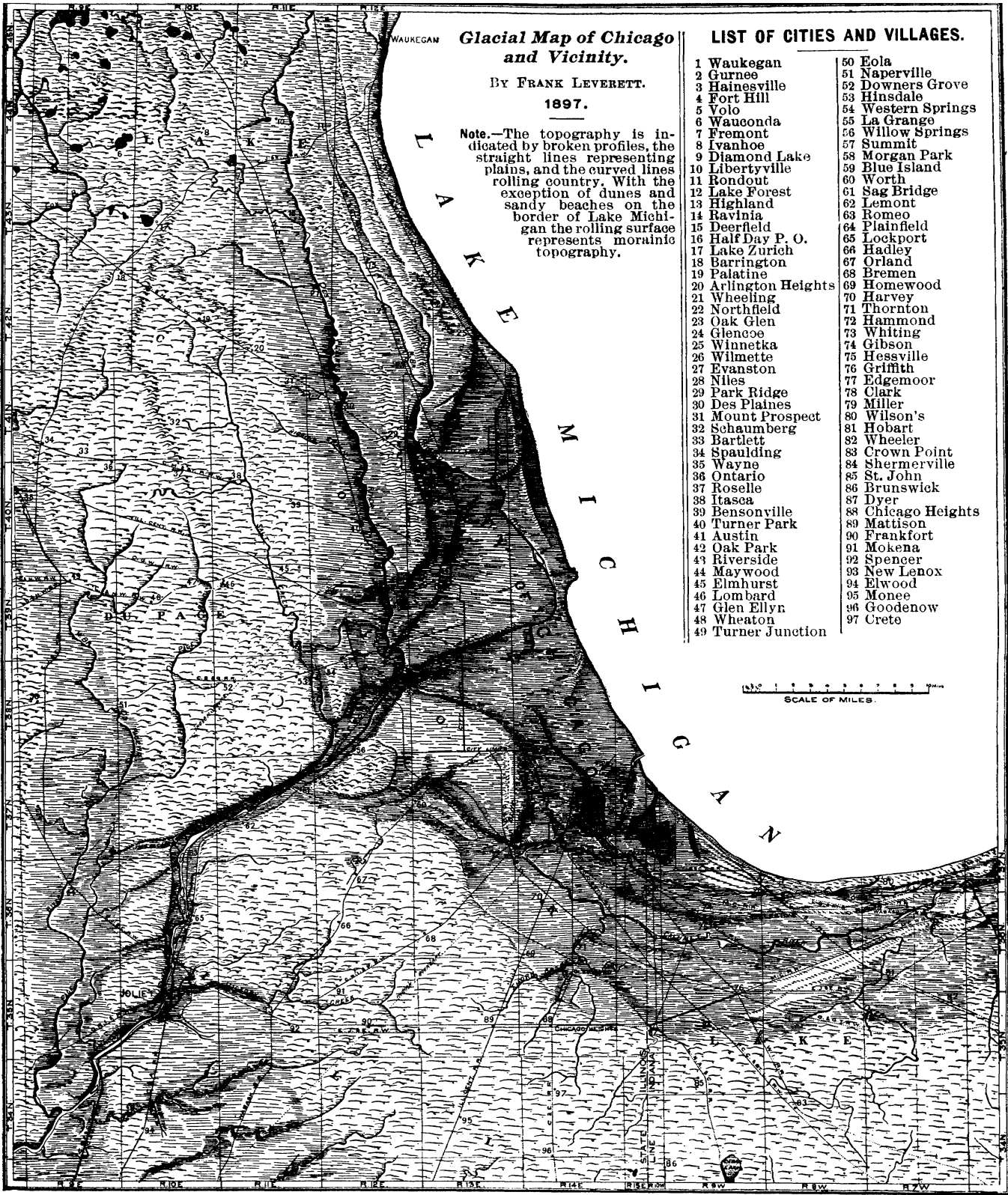


Fig. 1.

"EXPLANATION OF GLACIAL MAP OF CHICAGO AND VICINITY.—On this map an attempt is made to give a bird's-eye view of the area by means of broken profiles. The moraines appear with undulating contour, the plains with straight lines, the beaches with abrupt, step-like descent of the plain. Striae are indicated by arrows and represent bearings accurately. Some confusion of dunes with moraines may arise if it is not borne in mind that the belt of ridges bordering Lake Michigan in Lake County, Indiana, consists of sand dunes. The dunes are found for eight to twelve miles south from the lake in that county. The bars in Cook County, Illinois, also are to be distinguished from the moraines. They are much lower and narrower ridges, as shown in the discussion."—*Leverett, Pleistocene Features*, p. 23, pl. iii, 1897.

abundant south, but are generally absent north, and the same may be said of the *Sphæria* and *Pisidia*. In the western part of the area there are several species which are not found in either of the other two regions.

The writer, from a study of the material at hand, would divide the area embraced in the survey into three regions, as follows:

FIRST.-- The region lying north of the mouth of the Chicago River and east of the Desplaines River, including in its territory the north branch of the Chicago River and its tributaries. The ground is generally high and free from swamps. The drainage is into Lake Michigan by the Chicago River principally, but also by several small creeks about Evanston. The district is heavily wooded in many places and is especially favorable to the development of land shells; but few fresh-water species are found. The following species inhabit this region and, so far as known, are not found in the other regions:

*Philomycus oarolinensis*.

*Limnæa columella*.

*Pupa corticaria*.

SECOND.-- The region lying south of the Chicago River and east and south of the Desplaines River, including the townships of Lake, Hyde Park, Calumet, Worth, Bremen, Thornton, Rich and Bloom, and all of the territorial region in Lake County, Indiana. The land here is generally low and swampy and contains the chain of lakes before mentioned. Woodlands are scattered about and the region is equally as well suited for land as for freshwater shells. The drainage is into Lake Michigan through the small lakes and the Grand and Little Calumet rivers. The Illinois and Michigan Canal somewhat mingles the two systems of drainages. Unios are particularly abundant. The species tabulated below appear to be peculiar to

*Obliquaria reflexa*.

*Polygyra inflecta*.

*Quadrula trigona*.

*Polygyra tridentata*.

*Quadrula verrucosa*.

*Gastrodonta ligera*.

*Quadrula lachrymosa*.

*Gastrodonta demissa*.

*Quadrula pustulata*.

*Physa ancillaria*.

*Plagiola elegans*.

*Pleurocera subulare*.

*Plagiola donaciformis*.

*Campeloma ponderosum*.

*Lampsilis multiradiatus*.

*Lampsilis gracilis*.

*Sphærium fabale*.

THIRD.--The region lying west of the Desplaines River, including the river, together with the townships of Palos, Or-

land, Frankfort, Lemont, Homer, New Lenox, Lockport and Joliet. The territory consists principally of rolling prairies; swamps, except near the rivers, are absent. The drainage is into the Illinois, thence to the Mississippi River through the DuPage, Desplaines and tributaries of the Fox rivers. Woodlands are found along the river banks which afford a retreat for the land snails. The fresh-water forms are abundant. The following species are peculiar to this region:

<i>Anodonta imbecilis.</i>	<i>Sphærium transversum.</i>
<i>Quadrula parva.</i>	<i>Sphærium truncatum.</i>
<i>Quadrula plicata.</i>	<i>Sphærium securum.</i>
<i>Quadrula coccinea.</i>	<i>Pisidium politum.</i>
<i>Alasmodonta pressa.</i>	<i>Omphalina fuliginosa.</i>
<i>Unio hildrethianus.</i>	<i>Vallonia parvula.</i>
<i>Lampsilis anodontoides.</i>	<i>Pupa procera.</i>
<i>Lampsilis ligamentinus.</i>	<i>Pupa holzingeri.</i>
<i>Lampsilis spatulatus.</i>	<i>Pleurocera elevatum intensum.</i>
	<i>Elimia livescens depygis.</i>

We find the following species to be equally distributed throughout our area:

<i>Anodonta grandis.</i>	<i>Pupa curvidens.</i>
<i>Anodontoides subcylindraceus.</i>	<i>Succinea obliqua.</i>
<i>Strophitus edentulus.</i>	<i>Succinea avara.</i>
<i>Alasmodonta complanata.</i>	<i>Succinea ovalis.</i>
<i>Lampsilis luteolus.</i>	<i>Carychium exiguum.</i>
<i>Unio gibbosus.</i>	<i>Carychium exile.</i>
<i>Quadrula rubiginosa.</i>	<i>Limnæa desidiosa.</i>
<i>Quadrula undulata.</i>	<i>Limnæa humilis.</i>
<i>Sphærium stamineum.</i>	<i>Limnæa caperata.</i>
<i>Sphærium striatinum.</i>	<i>Limnæa cubensis.</i>
<i>Sphærium partumeium.</i>	<i>Limnæa palustris.</i>
<i>Pisidium abditum.</i>	<i>Limnæa palustris michiganensis.</i>
<i>Vitrea arborea.</i>	<i>Limnæa reflexa.</i>
<i>Vitrea hammonis.</i>	<i>Planorbis trivolvus.</i>
<i>Vitrea indentata.</i>	<i>Planorbis parvus.</i>
<i>Conulus fulvus.</i>	<i>Segmenting armigera.</i>
<i>Gastrodonta nitida.</i>	<i>Ancylus rivularis.</i>
<i>Gastrodonta minuscula.</i>	<i>Physa heterostrophæ.</i>
<i>Limax campestris.</i>	<i>Aplexa hypnorum.</i>
<i>Pyramidula alternata.</i>	<i>Pleurocera elevatum.</i>
<i>Pyramidula striatella.</i>	<i>Elimia livescens.</i>
<i>Pyramidula lineata.</i>	<i>Amnicola limosa.</i>
<i>Vallonia pulchella.</i>	<i>Valvata tricarinata.</i>
<i>Polygyra thyroides.</i>	<i>Vivipara contectoides.</i>
<i>Polygyra profunda.</i>	<i>Campeloma rufum.</i>
<i>Polygyra hirsuta.</i>	<i>Campeloma decusum.</i>
<i>Pupa contracta.</i>	<i>Campeloma subsolidum.</i>





TABLE SHOWING THE COMPARATIVE DISTRIBUTION OF SPECIES.—CONTINUED.

[illegible]

**SPECIES.**

SPECIES.	NORTHERN REGION. LAKE DRAINAGE.										SOUTHERN REGION. LAKE DRAINAGE.										WESTERN REGION. MISSISSIPPI RIVER DRAINAGE.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
	Winnetka.	Evanson.	Bowmanville.	N. Br. Ch. Riv.	Buena Park.	Wheeling.	Lincoln Park.	Edgemoor.	Avondale.	Bohemian Cem.	Lake View.	Lake Shore.	Wolf Lake.	Calumet Lake.	Hyde Lake.	Berry Lake.	George Lake.	Roby.	Mud Lake.	Liverpool.	Calumet River.	Little Cal. R.	Lake Shore.	Shelfield.	Hammond.	Blue Island.	Miller's.	Washington Pk.	Rivendale.	Morgan Park.	Worth.	Pine Station.	S. Br. Ch. Riv.	Maywood.	Riverside.	Dunning.	Lemont.	Milton T'w.p.	Joliet.	Hickory Creek.	DuPage River.	Willow Sp'gs.	Lisle T'w.p.	Rock Run.	Bird's Bridge.	Ill. & Mich. Can.	Naperville.	Lockport.	Romeo.	Salt Creek.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
Testacella haliotoidea	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

TABLE SHOWING THE COMPARATIVE DISTRIBUTION OF SPECIES—CONTINUED.

SPECIES.	NORTHERN REGION. LAKE DRAINAGE.	SOUTHERN REGION. LAKE DRAINAGE.	WESTERN REGION. MISSISSIPPI RIVER DRAINAGE.
114. Planorbis trivolvis.....	* Winneka..	*	* Maywood..
116. " truncatus .....	* Evanston..	*	* Riversside..
117. " bicarinatus .....	* Bowmanville..	*	* Lemont..
118. " complanatus.....	* N. Br. Chi. Riv.	*	* Dunning..
119. " exacutus.....	* Buena Park..	*	* Milton T'w.p.
120. " parvus.....	* Wheeling..	*	* Joliet..
121. Segmentina armigera.....	* Lincoln Park..	*	* Hickory Creek..
122. Ancyclus rivularis.....	* Edgemoor..	*	* Willow Spgs.
123. " tardus.....	* Avondale..	*	* DuPage River..
124. Physa heterostropho....	* Bohemian Cem.	*	* Rock Run..
125. " ancillaria .....	* Lake View..	*	* Bird's Bridge..
126. " ancillaria .....	* Lake Shore..	*	* Ill. & Mich. Can.
127. Aptexa hypnorum.....	*	*	* Naperville..
128. Pleurocera subulare.....	*	*	* Lockport..
128a. " intensum.....	*	*	* Romeo..
129. " elevatum .....	*	*	* Salt Creek..
129a. " lewisii .....	*	*	*
130. Elimia livescens.....	*	*	*
130a. " depygis .....	*	*	*
131. Bythinia tentaculata .....	*	*	*
132. Annicola limosa.....	*	*	*
133. " lustrica.....	*	*	*
134. Cincinnatia cincinnatiensis	*	*	*
135. " obtusa.....	*	*	*
136. Bythinella nickliniana.....	*	*	*
137. Somatogyrus subglobosus	*	*	*
138. " integer.....	*	*	*
139. Pomatiopsis cincinnatiensis	*	*	*
140. " lapidaria .....	*	*	*
141. Valvata sincera.....	*	*	*
142. " tricarinata.....	*	*	*
143. Vivipara contectoides.....	*	*	*
144. Campeloma ponderosum	*	*	*
146. " rutum.....	*	*	*
146. " decium.....	*	*	*
147. " subsolidum.....	*	*	*

## V. GEOLOGICAL DISTRIBUTION.

The geological distribution of the land and fresh-water species in the area is but imperfectly known. The shells of *Unio*, *Elimia*, *Limnæa*, *Planorbis* and *Ancylus* have been found in considerable abundance in the beach at Evanston, near the University. In the township of Worth, three miles west of Morgan Park, the shells of *Limnæa*, *Planorbis* and *Physa* have been found buried to the depth of several feet, and the specimens were perfectly preserved. The following species have been found and are in the collection of the Academy:

*Quadrula trigona*---Corner Wrightwood Avenue and North Clark Street; excavations for building.

*Quadrula undulata*—Corner Frederick and North Clark Streets; excavations for building.

*Quadrula* sp. (apparently between *trigona* and *rubiginosa*)—Hall Street; excavations for building.

*Polygyra thyroides*—Foot of Argyle Street, near the Lake.

*Limnæa caperata*—Worth.

*Limnæa cubensis*--Worth.

*Limnæa palustris*--Worth.

*Limnæa reflexa*--Worth, and foot of Argyle Street.

*Limnæa stagnalis*—Near Calumet Lake.

*Physa heterostropha*--Worth.

*Pleurocera elevatum*—In beach, corner Sheffield and Lincoln Avenues.

*Elimia livescens*—In beach, corner Sheffield and Lincoln Avenues.

*Elimia livescens*---In beach, Balmoral Avenue north of Bowmanville.

*Cameloma decisium*—Near Calumet Lake.

At Willow Springs, in the river bank, the following species were collected by Mr. Jensen:

*Anodonta grandis*.

*Unio gibbosus*.

*Quadrula rubiginosa*.

*Sphærium stamineum*.

*Sphærium simile*.

*Planorbis trivolvis*.

*Physa heterostropha*.

*Cincinnatia obtusa*.

*Cincinnatia cincinnatiensis*.

*Amnicola limosa*.

In the sand banks east of Sheridan Drive and north of Grace-land Avenue, Mr. Jensen collected the following species:

*Sphærium striatinum*.

*Isidium virginicum*.

*Limnæa desidiosa*.

*Limnæa cubensis*.

*Planorbis bicarinatus*.

*Elimia livescens*.

*Somatogyrus subglobosus*.

*Cameloma subsolidum*.

The same collector found the following species in a sub-fossil condition (buried in loam) at Bowmanville:

*Polygyra albolabris*.

*Polygyra profunda*.

*Pyramidula alternata*.

At Evanston, in the beach near The Northwestern University, the following species have been collected by Prof. Oliver Marcy:

Unio of various species.	Physa heterostropha.
Limnæa palustris.	Ancylus sp.
Limnæa caperata.	Elimia livescens.
Limnæa reflexa.	Pleurocera elevatum.
Planorbis trivolvis.	

The fossils are sometimes found in clay and sometimes in carbonaceous earth. The following section\* shows the general position of the strata in relation to the fossils:

SECTION OF BEACH AT EVANSTON MADE IN 1864.

	FEET.
1. Surface soil, sandy.....	1½
2. Brown sand and fine gravel.....	2½
3. Coarser gravel, stratified .....	2½
4. Fine sand.....	2
5. Gravel, containing bones of deer.....	1½
6. Fine sand, containing oak logs.....	1½
7. Peat or carbonaceous earth with a marl bed containing molluscan shells in the lower portion or interstratified with the peat.....	1½
8. Gravel .....	¾
9. Humus soil, with stumps and logs (coniferous).....	½
10. Yellow clay, laminated and contorted, containing pockets of gravel .....	¾
11. Blue, pebbly clay.....	2
Height of bluff.....	22

Mr. Carl Dilg has found a number of fossil shells in excavations for the foundations of flat buildings and has made collections at the corner of Wrightwood Avenue and Clark Street, corner of Frederick and Clark Streets, on Hall Street, corner Sheffield and Lincoln Avenues and on Balmoral Avenue south of Bowmanville. The genera found were Unio, Pleurocera and Elimia.

It is probable that many additional species of fossil mollusks will be found when the area is more systematically surveyed for this purpose.

\*From Leverett, after Marcy, Pleistocene Features, p. 76.

## VI. INSTRUCTIONS FOR COLLECTING MOLLUSKS.\*

Before proceeding to discuss the particular species found within the limits of the area, it may not be out of place to briefly consider the methods of collecting and preserving specimens of this group.+ Mollusks may be found in all parts of Illinois in almost every situation; in the woodlands, the swamps, the creeks and rivers and the lakes. Even the prairies have given us several species of this type. For convenience we will divide the group into two sections, viz.: 1. Land species. 2. Freshwater species.

## I. LAND SPECIES.

The land mollusks cover a variety of widely separated forms; some are with, others without shells; some are herbivorous and others are carnivorous.

*a. HABITAT.*--Land mollusks exist under almost all conditions. In an old forest they will be found under dead leaves and decaying logs. The bark of old trees which is "starting," and old, rotting stumps will be found prolific collecting stations. The shelter of loose stones and boulders is also good ground for these animals. Other forms live on the leaves of sedges, grass and shrubbery. During the winter months these animals bury themselves in the soil at the base of these grasses and shrubs. A limestone region is the most conducive to the life and growth of land snails, and in this kind of a region they are very plentiful, while in a country composed of quartz (flint) they will not thrive and are seldom found. Where coniferous or resinous trees abound few if any mollusks will be found, while in a locality made up of deciduous or soft-wooded trees the snail fauna will be abundant and varied. Pungent herbs are inimical to snails, while the nettles are favorite localities for them. No pulmonate mollusk will live where sand, ashes or lime in a pure state are found.

The spring months are the best suited for the active life of snails, but it is not until midsummer that they reach their maximum development. During the winter months they bury themselves in the ground, closing the aperture of the shell with a leathery secretion called an epiphragm; the naked slugs cover

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\*For much of the information used in this topic the author is indebted to Dr. Wm. H. Dall's "Instructions for Collecting Mollusks, and Other Useful Hints for the Conchologist," being part G of Bull. No. 39, U. S. National Museum.

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+The writer has inserted this topic for the reason that works upon this subject are not always to be obtained, and principally so that the reader of this report might have all the necessary information before him without consulting other works.

themselves with this secretion much as a caterpillar does with a cocoon. Many times several epiphragms will be found in a single snail. Most land mollusks live but two or three years, although some exotic forms, like the desert snails of Africa, live for a much longer time.

*b. COLLECTING OUTFIT.*--Among the most useful collecting tools needed may be mentioned a pair of small spring forceps; the points should be slender and meet together perfectly. They are indispensable in picking up minute Pupæ and Vitræ, as well as for sorting over the collection after the day's work. The common homoeopathic vial is also an invaluable adjunct to store small forms as collected. The cork, however, should be attached to the neck of the vial by a thread, so that it will not be lost in the underbrush. A couple of wide mouthed two ounce bottles serve well for large species. A tin box, like a mustard box, which fits the pocket well, is often found very useful to carry snails the size of *Polygyra thyroides*; care should be used in putting the snails in the box or they will get broken. A piece of cotton in the bottom of the can will prevent this. When the small species like *Pupa* and *Vitrea* are desired simply for their shells, it will be a good plan to fill the homoeopathic vials half full of thirty per cent. alcohol. This will abstract the moisture and keep away any offensive smell which might arise from them. This also prevents them from adhering to the sides of the bottle and to themselves, when it is a difficult matter to remove them without breaking. In collecting species inhabiting bushes, an insect net will be found of great value in which to catch them as the bushes are shaken. The writer has used an open umbrella, inverted, for the same purpose. A small trowel and a large knife are always of great use in digging about rotten logs and tearing the bark from decaying trees. A pocket lens of about ten diameters is an invaluable addition to a collector's outfit, and a large reading glass is very useful in aiding in the preliminary sorting of the day's catch. A stout wooden rake with a long handle will be found of great value in raking hillsides and under bushes.

*c. FAVORABLE LOCALITIES.*--Pulmonate mollusks may be looked for in the following localities: The under surface of old, weather-worn pieces of board, bones or leather; the earth about rotting stumps and under stones and fallen logs; moist moss under rocks; under overhanging ledges; in marshes and the margins of brooks and ponds. If the debris left by freshets



along the borders of a stream be examined it will frequently yield a rich harvest of small snails. In other words any cool place where there is plenty of shelter and moisture will be found a good locality for these animals. In forests mollusks will be found abundantly where soil is plentiful and where there are numerous open spots. They will not be found in woodlands of spruce or pine.

When search is being carried on for the animals and shells the eggs should not be forgotten, for they are of great importance. These will be found in about the same localities as the mollusks themselves, in cool, moist places. They may be known by their white color, leathery texture and the pellucid membrane in which they are enclosed. They resemble little balls of jelly, and are generally found in a mass, although deposited singly. Since the embryological development of but few mollusks is known, any careful student may find here a wide field for original investigation.

If it is found desirable to keep some of the animals alive they may be put in a box filled with moist earth. A large fish globe is very useful for this purpose. Everything done by the animals should be noted, especially the manner of eating and kind of food taken.

## 2. FRESH-WATER SPECIES.

Both gastropods and pelecypods are found in fresh water. Any region having ponds, streams, ditches, brooks, etc., will support a fresh-water molluscan fauna.

*a. HABITAT.*—A body of water with a quantity of lime in solution and with a muddy bottom will yield the largest variety of mollusks, since lime is essential to the building up of the shell. A coarse crystalline gravel is less adapted to them than is soft, less gritty sands and mud.

A rapid current is not favorable, although a number of mollusks (as the *Pleuroceridæ*) are found on rocks over which a rapid stream is flowing. A stream filled with decaying vegetation is unsuited to molluscan life from the presence of carbonic acid ( $\text{CO}_2$ ) arising from its decay. This not only affects the life of the animal, but causes an excessive erosion of the shell, in the repair of which the animal is weakened by the enforced secretion of shelly matter.

Gill-bearing mollusks will not voluntarily inhabit a stream holding impalpable mud in suspension, nor in waters charged

with salts of various kinds. Many times, however, some hardy species survive in even brackish water; the effect of such a habitat is to dwarf and otherwise distort the shell. Some salt water species are known to inhabit both brackish and fresh water.

The small bivalves, *Pisidium* and *Sphærium*, prefer mountain pools, wet meadows, ponds and ditches. *Anodonta* prefers large ponds and slow moving streams, while the stouter *Unio* lives best on a hard, rocky bottom; in sandy bottoms they may be seen pushing themselves about quite rapidly. In ponds and sluggish streams the genera *Physa*, *Limnæa*, *Planorbis* and *Amnicola* are found abundantly. Lily pads are good habitats for small mollusks, as are also the roots of trees and blades of swamp grass.

*b. COLLECTING OUTFIT.* —A fish basket makes a good collecting receptacle. A large basket is invaluable to carry the larger species like *Unio* and *Anadonta*. A dip net will be found useful to dredge for those species which inhabit a muddy bottom. The small or minute species may be put in small vials, as mentioned for land shells. A flat bladed knife, or small trowel, and a pair of tweezers will complete the outfit. A scoop made of fine wire gauze will make a useful dredge to scoop the mud of shallow ponds and rivers.

A small dredge, similar to those used in deep sea dredging, is of great value in collecting in the larger lakes. A strong man, or better, two men should row the boat and the one having charge of the dredge should be ever on the alert for obstructions on the bottom so that the dredge may not be damaged. A lead should be prepared with a hollow base in which to place some kind of grease to ascertain the character of the bottom, whether sandy or muddy, and should be attached to a stout line marked off in feet, to record the depth. These points should always be carefully noted with each haul, together with the distance from the shore.

*c. FAVORABLE LOCALITIES.*— In (*a*) a number of good localities have been given. Muskrat burrows are always good localities for the *Unionidæ* and the shells may frequently be found perfectly cleaned. The drift along the shore will yield a goodly number. As spoken of under land shells, so with fresh-water species, the eggs should be collected and preserved for study during development. These resemble drops of transparent jelly. For the preservation and study of the eggs, as well as small forms of adult mollusks, a small fish globe will serve as an excellent aquarium. Any jar of medium size will do equally as

well, however, and even a good sized tumbler will answer the purpose.

Care should be taken to record all observations, as much information is needed concerning the embryological development of the fresh-water mollusks.

### 3. PRESERVATION OF COLLECTIONS.

The preservation of the collections obtained on each day's trip is of great importance, for upon this depends the appearance and value of the collector's cabinet. When the specimens are collected they are covered with mud and growths of various kinds, and must be thoroughly cleaned. In the case of land and fresh-water shells, they should first be washed clean of mud, etc.; this may be rendered easier by the aid of a tooth-brush. The soft parts may be removed by putting the animal for a few seconds in boiling water. If they are first placed in lukewarm water for a few minutes and then transferred to the boiling water it will prevent cracking and preserve the polish which is frequently lost when delicate shells are immediately placed in boiling water. The animal may be extracted from the shell with a crooked pin or wire, or better still, a small pair of tweezers. Those species having an operculum should have it carefully removed and attached to a piece of cotton, which may be placed in the aperture of the shell. Some opercula warp out of shape while drying, and it will be found a good rule to place them between two boards during this process. Some of the shells may be covered with incrustations of lime and peroxide of iron, and to remove these an old file or small bone scraper will be found useful. The file should be ground to a point. Naked mollusks (slugs) may be preserved in alcohol or formalin. The internal shell of *Limax* may be extracted and preserved if desirable, but the better method is to prepare the whole animal. Shells that are stained with iron or other matter may be perfectly cleaned by placing for a few moments in a solution of oxalic acid.

Unios and other bivalves should have the animal removed with a flat-bladed knife. To do this the two adductor muscles must be cut, after which the valves will open and the animal may be entirely cut away. If the shells are left in the sun for a few hours they will gape and the animal may then be easily removed. The two valves should be tied together in their natural position. Care should be used in cleaning the shell so

that the hinge ligament will not be injured. In the case of shells having an epidermis, they may be greased with vaseline to prevent cracking when dry. Care should be used not to apply it in too large quantities or the shells will feel greasy. After applying the vaseline it should be thoroughly rubbed in with a flannel rag and all surplus grease removed. Small gastropods need not be removed from the shell, but may be put in alcohol for fifteen or twenty minutes, after which they may be dried and placed in the cabinet. The collector will undoubtedly find numerous ways of improving his cleaning and preserving methods, as experience dictates.

The methods of labeling need not be dwelt upon here. All manner of schemes are used by conchologists in mounting and preparing specimens for the cabinet. Some use cardboard labels with a space for the specimens and another for the name, etc.; others simply use pasteboard trays, allowing the shells to remain loose instead of attaching them as in the case of the cardboard tablets. In the collections of The Chicago Academy of Sciences all specimens are attached to these tablets and they present a handsome appearance; but this is hardly feasible for the cabinet of a private collector, for lack of room. A good cabinet of drawers three inches in depth will suffice for most of the land and freshwater shells, although several deeper drawers may be found useful for large unios. In writing the labels the generic and specific names and the authority for the name should occupy the first line, and the locality and name of the person from whom the specimens were received may occupy the balance of the label; the bottom of the latter might be used to advantage for short notes relating to the habits or peculiarities of the individuals in the tray.

The following sample shows the manner of doing this:

No. 197.	Sex ♂	Date 6-14-95.
UNIO LUTEOLUS Lamarck.		
Set showing variation due to age.		
Calumet Lake near Pullman.		
Coll. by John Smith.		
<hr/>		
Found in a muddy bottom on a sloping shore, in two feet of water. Specimens plentiful.		

It is always a good idea to keep a catalogue of the collec-

tion. Each tray of specimens should be numbered and entered in the catalogue, together with all possible information. A card catalogue is also of great value.

#### 4. PRESERVATION FOR ANATOMICAL USE.\*

It is sometimes desirable to preserve the soft parts of mollusks for anatomical and microscopical use. This may be done in the following manner: Land and fresh-water gastropods may be killed by drowning, which can be done by putting them in an air tight vessel filled completely with water so as to exclude all the air. By this means the soft parts will be more extended than if killed by boiling water, as recommended for cabinet specimens. They should then be gradually hardened as follows: Thirty per cent. alcohol, twenty-four hours; seventy per cent. alcohol, thirty hours, and eighty-five per cent. alcohol for final preservation. A one per cent. solution of chromic acid makes a good reagent, and the object, if not too large, may be left in it for twenty four or thirty hours, after which they should be thoroughly washed in running water for twenty-four hours until the acid is removed.

It is of great importance that the radula or lingual ribbon should be preserved for study. This is a strap or belt of chitinous or horny matter, occupying the place in the mouth of the animal analogous to that occupied by the tongue in the vertebrates. The apparatus is protrusile and may be studied by feeding a snail, *Limnæa stagnalis* for example, soft crumbs of bread. In the larger forms it may be found with but little trouble, but the smaller forms must be boiled in caustic potash. This is accomplished as follows: Extract the animal from its shell and place in a test tube containing a tablespoonful of caustic potash which has become liquid by the attraction of atmospheric moisture. Hold the test tube at the side of the flame of an alcohol lamp until it boils, being careful not to let it boil over and that the animal matter is not thrown out of the liquid on to the dry side of the tube; if this happens dislodge it by shaking the liquid over it. Boil slowly until the animal matter is dissolved, then pour it out quickly into a watch crystal, refill the test tube with water and pour into another watch crystal. Give the first crystal a rotary motion, not too violent, so as to bring the solid particles to the center. Examine with a powerful hand lens; a sheet of white paper under the watch

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\*See Dall, 1. c., p. 43.

crystal will greatly aid in discovering the radula. This will be recognized by its curved, elongate shape and apparently reticulated surface. If the radula is not found in the first crystal, examine the second. When found, in either one of the two crystals, transfer to a glass slide and examine under the microscope with powers ranging from one inch to one-eighth inch. It had best be examined by transmitted light.

After examining and sketching the form of the radula, it will be necessary to tear the ribbon up so as to get separate rows and individual teeth, since they lie over one another like shingles on a roof. The whole of one tooth cannot always be seen under one focus, because the recurved cusps of the teeth are higher than the base. When the teeth are very transparent it will be found necessary to stain the radula. To do this, first carefully clean the radula, then put it in a drop of strong solution of chromic acid; this stains it yellowish brown. It may then be mounted in glycerine jelly. Canada balsam is not a desirable medium, since it makes the object too transparent.

The teeth are disposed upon the radula in five principal longitudinal rows, which are easily distinguished. There is always one median longitudinal row of unpaired teeth, with several rows on either side. The central tooth is called the median or *rhachidian*. The teeth on either side are called laterals or *admedian*, and when there is an outer row of different teeth they are called marginals or *uncini*. In describing the teeth notes should be made of the form of the base of attachment, especially in the central tooth; also other special characteristics, such as simple, straight, curved or compound. Each tooth (as the central) may be made up of a number of projecting cusps, and great care should be used in describing and sketching these. In describing the radula, a dental formula is used to express the number and situation of the teeth and cusps; thus, if a radula has a single central, three lateral and twelve marginal teeth, and the first series has five cusps, the second series four and the third series one cusp, the formula would be expressed as follows:

$$^{12}/_1+^3/_4+^1/_5+^3/_4+^{12}/_1$$

The unit representing the tooth is written as a numerator and the number corresponding to the cusp as a denominator.\*

\*For further information on this subject, the reader is referred to the paper of Dr. Dall spoken of above, from which the present information has been drawn.

## VII. ECONOMY OF THE MOLLUSCA.

While the land and fresh-water species of the area are of no particular economic use to man, save as bait for fishing, yet in an indirect way they are of great benefit to him in furnishing food for birds and fish. Ducks and wading birds are particularly fond of such species as *Bythinella nickliniana*, *Amnicola limosa*, and other small univalves, not to speak of numerous small forms of *Pisidia* and *Sphæria*. Passerine birds are fond of *Pupa*, *Vertigo* and small *Limaces*. Fish eat mollusks as large as *Campeloma decisum*, and even extract the animal from *Unios*.\*

*Limax campestris* is said to be eaten by the red salamander (*Plethodon erythronotus*, Green+) and it is probable that many animals, of whose food supply nothing is known, feed upon mollusks. It not infrequently happens that a too inquisitive animal gets caught in trying to obtain molluscan food, an instance of which passed before writer's notice some time ago. This was a western painted terrapin (*Chrysemys marginatus*) whose right hind foot had been caught and tightly held by a vigorous specimen of *Unio luteolus*. A similar case of a sora rail (*Porzana carolina*) has been noted, although the bird was probably not seeking the *Unio* for food.‡

There are many forms of mollusks (*Pulmonata*) which are hurtful to man by injuring his plants or gardens. Our green-houses are infested with several European species, which have been introduced into the country by means of imported plants. These are *Limax maximus*, *L. flavus* and *Vitrea cellaria*. In the greenhouses they are sought after daily and killed by being placed in boiling water. It is probable that many of our larger species prey upon cultivated fields, although the writer has not heard of such being the case in the present area. A good way to keep them out of a cultivated patch is to spread a layer of dry ashes, some two feet in width, around the plot of ground. When the mollusk meets this obstruction it will secrete mucus so fast that it will soon die from exhaustion.

## VIII. STATISTICS.

The following tables have been introduced to enable the reader to compare the molluscan fauna of this area with that of

\*See *The Nautilus*, Vol. V., p. 128.

+Witmerstone, *The Nautilus*, Vol. III., p. 19.

‡*The Nautilus*, Vol. IX., p. 49.

other areas. The total number of species and varieties is 153, distributed among twenty families and fifty genera. These may be primarily grouped as follows:

1. Native species and varieties.....	147
2. Introduced species....	6
Total number of species.....	153

### 1. SYSTEMATIC DISTRIBUTION.

GROUP.	Orders.	Families.	Genera.	Sp. & Var.
Gastropods.....	3	18	38	103
Pelecypoda .....	2	2	12	50
Total.....	5	20	50	153

### 2. COMPARISON WITH THE UNITED STATES.

GROUP.	Chicago.	U. S.*
Families .....	20	35
Genera .....	50	98
Species .....	147	3000
Varieties .....	6	300

### 3. COMPARISON WITH MICHIGAN.

GROUP.	Chicago.	Michigan.+
Families.....	20	17
Genera.....	50	49
Species.....	147	246
Varieties.....	6	19

### 4. COMPARISON WITH PENNSYLVANIA.

GROUP.	Chicago.	Allegheny Co., Pa. §	Philadelphia and Environs.
Families .....	20	15	19
Genera .....	50	30	40
Species.....	147	91	84
Varieties .....	6	2	3

\*The numbers for the United States are only approximate, as there is no recognized catalogue of the mollusks of this region.

+ "The Shell-bearing Molluscs of Michigan," by Bryant Walker. The Nautilus, Vol. VI., pp. 13, 31, 42, 63, 135. In all these tables, some species and varieties considered distinct by the authors are here considered synonyms, the better to compare with the present list.

§ "Land and Fresh-Water Shells of Allegheny County, Pa.," by S. H. Stupakoff. The Nautilus, Vol. VII., p. 135; Vol. VIII., p. 116.

|| "Mollusk Fauna of Philadelphia and Environs," by Morris Shuck. The Nautilus, Vol. VIII., p. 133.



## 5. COMPARISON OF GENERA.

In this table all the species of each genus found within the two limits are given.

GROUP.	Chicago.	Cincinnati, Ohio.
1. Anodonta.....	3	3
2. Margaritana .....	10	13
3. Unio.....	24	67
4. Sphærium .....	9	8
5. Pisidium.....	4	1
6. Pleurocera.....	4	5
7. Goniobasis (Elimia) .....	2	3
8. Anculosa.....		2
9. Pomatiopsis .....	2	1
10. Somatogyrus.....	2	2
11. Amnicola .....	2	
12. Cincinnatia .....	2	1
13. Campeloma (Melantho).....	4	4
14. Vivipara.....	1	
15. Lioplax.....		1
16. Valvata .....	2	1
17. Bythinella.....	1	
18. Bythinia.....	1	
19. Ancyclus.....	3	2
20. Segmentina .....	1	1
21. Planorbis .....	7	5
22. Physa.....	2	2
23. Aplexa.....	1	
24. Lymnæa.....	11	4
25. Carychium.....	2	1
26. Succinea.....	3	5
27. Vertigo .....	1	2
28. Pupa .....	9	7
29. Ferussacia (Cionella) .....	1	1
30. Punctum ..	1	1
31. Strobilops (Strobila).....	1	1
32. Circinaria (Macrocyclus).....	1	1
33. Vitrea (Hyalina).....	4	4
34. Omphalina (Zonites) .....	1	3
35. Gastrodonta (Zonites).....	4	7
36. Conulus (Hyalina).....	1	1
37. Helicodiscus.....	1	1
38. Pyramidula (Patula).....	3	4
39. Polygyra (Stenotrema, Mesodon, etc.).....	14	18
40. Vallonia.....	3	2
41. Limax .....	3	3
42. Philomycus (Tebennophorus).....	1	1
43. Testacella .....	1	0
Total	153	189

\* "Catalogue of Land and Fresh-Water Shells Found in the Vicinity of Cincinnati, Prepared for the Use of Beginners," by George W. Harper, A. M. Journal Cin. Soc. Nat. Hist., Vol. VIII., p. 89.

## IX. ANATOMY OF THE SHELL.

For the benefit of those who may not be familiar with the different parts of the shell, but who may desire such a knowledge to aid them in understanding the relation of the terms used in this report to the objects, the following brief discussion of the external anatomy is presented:\*

The pelecypods (or lamellibranchiates) are characterized (so far as the area under consideration is concerned) by pronounced bilateral symmetry. Two mantle-lobes form the sides of the mollusk, and secrete the two flattened, subconical shells. These two mantle-lobes are prolonged into tubular siphons. The two valves are connected dorsally by a firm ligament, and the dorsal portion of the shell is specialized into teeth and sockets. Two large adductor muscles close the shell; these muscles are plainly indicated on the interior of the shell by the scars which they leave. The exterior of the shell is always covered with a thick epidermis.

In a specimen of *Unio luteolus* (Plate I.) we will notice the following characters: The anterior end (A) short and rounded, the posterior end (P) long and quadrate, the ventral margin (V) sharp, and the dorsal margin (D) rounded; the ligament (l), which holds the valves together; the lines of growth (lg), which mark resting stages in the growth of the shell; the lunule (lu), a portion of the hinge just above the teeth, and the umbo (u), (plural umbones), the nucleus (protoconch), or first part of the shell; this will be seen to be wrinkled and corrugated. The whole shell viewed from above (middle figure in plate) shows an elongated outline, with the ligament (l), lunule (lu), and umbones (u) in the center; the latter are frequently called the beaks.

On the interior of the shell we notice the following characters (lower figure): The long, external ligament which binds the valves tightly together, just above the lateral teeth (lt); this ligament acts as a spring to force the valves apart, the opposite from the muscles which pull them together. It is very brittle in the dried shell, but in the living animal is tough and firm. Beneath the ligament the two lateral teeth (lt) are seen, two long, ridge-like processes; in the right valve there is but one lateral tooth, which fits in between the two in the left valve. In front of these are placed the cardinal teeth (ct), two in number,

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\*In preparing this topic the writer has made frequent use of Tryon's *Structural and Systematic Conchology*, Vol. I., to which he would acknowledge his indebtedness.

which interlock with a single tooth in the right valve. These teeth are pyramidal in form. The lateral and cardinal teeth form the hinge, which with the ligament serve to guide the two shells in opening and closing. Above the cardinal teeth the umbo (u) is seen. At either end of the shell there is a scar which represents the basis of attachment of the anterior (a) and posterior (b) adductor muscles. A second smaller scar is seen posterior to the former, and is known as the anterior foot retractor muscle scar (c). Above the posterior adductor muscle scar there is a small scar which represents the attachment of the posterior foot retractor muscle (e). These scars are also known technically as cicatrices (singular cicatrix). In the cavity of the beaks are situated a number of small scars, the dorsal muscle scars, which represent the attachments of the small

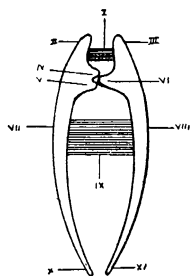


FIG. 2.

Diagram of a section of UNIO, showing method of opening and closing the valves. I., ligament; II., III., the umboes; IV., V., lateral teeth in the left valve; VI., lateral tooth in the right valve; VII., VIII., left and right valves of shell; IX., adductor muscle; X., XI., ventral surface of shell, or long arms of the lever. (After Lankester. )

muscles which hold the umbonal and dorsal part of the animal to the shell; they are numerous and deeply impressed.

As before remarked, the mantle or pallium secretes the shell substance (carbonate of lime); the edge of the pallium deposits new shell matter and adds to the size of the mollusk, It is firmly attached to the shell along a line which runs from the posterior to the anterior muscle scar, about half an inch from the ventral margin. This attachment is called the pallial line (pl) or pallial cicatrix.

The method of opening and closing the shell may best be represented by the accompanying diagram (Fig. 2, after Lankester) which is a transverse section of Unio, cutting through the ligament and adductor muscle. The two shells of a pelecypod form a double lever with the hinge teeth (IV., V., VI.) as

fulcrum. The ligament (I.) acts upon the short arms of the lever (the umbones, II., III.) as a spring, tending to keep the valves apart, or gaping. The adductor muscle acts upon the long arms of the lever (X., XI.) and by its contraction tends to keep the valves together. It will readily be seen that the mollusk is not at rest when the valves are tightly closed, for this requires some exertion on the part of the animal to pull them together and overcome the spring of the ligament. The period of rest is when the shells are slightly gaping.

The study of the structure of the shell is of great importance in understanding its formation and relation to the animal. If the shell of a *Unio* be broken so as to show a fractured edge, and studied with a powerful hand lens, the following structure will be seen (Fig. 3): An outer or epidermal layer, composed of almost

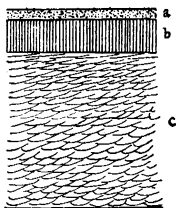


FIG. 3.

Diagram of a section of the shell of *UNIO TUBERCULATUS*, Barnes, showing the shell layers. a, epidermis; b, columnar layer; c, prismatic or inner layer. (Original.)

black tissue (a); a layer of columnar tissue (b) set at right angles to the epidermal layer; and a prismatic layer (c) forming the inner surface of the shell, and composed of thin plates of membrane and carbonate of lime placed alternately. The function of the epidermis is to protect the more calcareous portion from erosion by the carbon dioxide ( $\text{CO}_2$ ) in the water. The effect of this acid is seen on the umbones of the shells where the epidermis is thin or deficient. In most of the *Unios* the epidermis is green, olive green or black in color, and frequently rayed. It is formed by the cells on the edge of the mantle. Breaks which occur in the edges of the shell are easily supplied with the epidermal covering, but when they occur in the body of the shell, as at the upper third, no epidermal matter is deposited, but only nacreous matter, showing that it is the margin of the mantle which forms the epidermis.

In the gastropods (univalves) or snails the shell is in but one piece and is in the form of a spiral, except in *Ancylus* and *Limax*. In a specimen of *Polygyra albolabris* the following characters will be noticed (Fig. 4): The evenly wound, closely

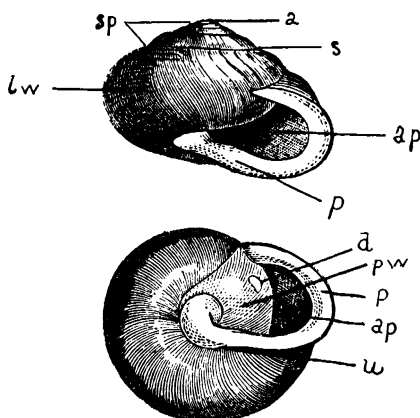


FIG. 4.

*POLYGYRA ALBOLABRIS*, showing parts of shell (after Binney, L and F-W, Sh; Figs. 227, 229). a, apex; ap, aperture; d, denticle; lw, last whorl; p, peristome; pw, parietal wall; s, suture; sp, spire; u, umbilicus.

coiled whorls; the small, light horn colored apex (a); the deeply impressed sutures (s); the large and swollen last whorl (lw); the wide aperture (ap); the white, reflected peristome (p) and the umbilicus (u) which is wide and deep in the young shell, but covered by the reflected peristome in the adult. The shell is also seen to be covered with rather coarse growth lines and also fine lines running parallel to the whorls. The parietal wall (pw) is covered with a spreading callus and has frequently a well-developed tooth or denticle upon it, situated near the upper part of the reflected peristome. In the gastropods, as in the pelecypods, the shell is a protection to the soft parts of the animal, which is attached to it only by the columella muscle. The structure of the shell substance is essentially the same as that described under the pelecypoda, except that the inner layer is not nacreous, and the outer layer, or epidermis, is not so heavy, except in some of the freshwater forms.

As in the pelecypods, the shell is secreted by the mantle and conforms closely to the shape of that organ. The spiral shells are nearly mathematically correct, as much so as a living body can be. Most gastropods, excepting Pulmonata, are pro-

vided with an operculum which is situated on the posterior dorsal portion of the foot, and is secreted by a portion of the skin known as the opercular mantle. The operculum is horny in the fresh-water shells and is used to close the aperture of the shell when the animal withdraws. The shell is, with but few exceptions (*Limax*) external and capable of holding the entire animal within it. The epidermis in most fresh-water gastropods is thick and heavy and protects the shell from the erosive agency of the carbon dioxide. The effect of such erosion is seen in the truncation of the spire of such mollusks as *Elimia*, *Pleurocera* and *Campeloma*. Land mollusks are not so much affected by this gas. In *Limnæa* and other shells with long spires, the parts of the shell appear a trifle different, although the names applied are the same. These are sufficiently shown in the cut (Fig. 5) and need not be dwelt upon.

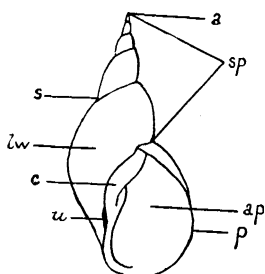


FIG. 5.

LIMNÆA, showing different parts of shell, a, apex; sp, spire; s, suture; ap, aperture; p, peristome; c, columella; lw, last whorl; u, umbilical region.

The external appearance of the animal presents the following characters (Fig. 6): The body is long and narrow and is differentiated into a head (h), tail, foot (f) and back, the latter covered with glandular tubercles arranged longitudinally. The head is connected with the body by a broad neck (n), and supports two eye-peduncles (ep), which bear at their extremities black, rounded eyes (e). Beneath the eye-peduncles are two short, blunt tentacles (t). The mouth is situated on the under side of the head in the middle line. The anal aperture is situated just above the mouth, a little to the right and a trifle to the rear.

The radula has now become such a factor in the study of the Mollusca that a knowledge of its characters is quite essential. As this organ is described for nearly all the gastropods cited in

this report, a brief discussion of the several parts of the teeth is here presented.

The buccal-body is placed either at the end of a rostrum or in the body of the head; in the former it is nonretractile. The

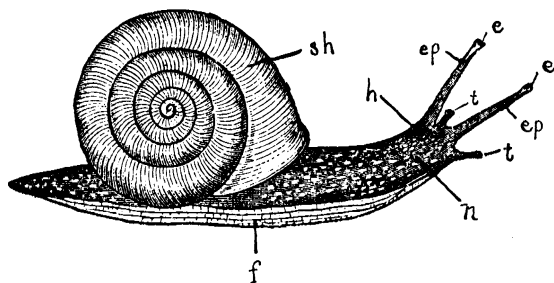


FIG. 6.

*POLYGYRA ALBOLABRIS*, showing parts of animal. (After Finney, L. and F-W, Sh., fig. 230.) e, eye; ep, eye-peduncles; f, foot; h, head; n, neck; sh, shell; t, tentacles.

odontophore (or radula) is formed in the radula sac (Fig. 7, 18), where it is pushed forward as needed. Anteriorly the ventral portion of the pharynx forms a stout cartilage (5) which is provided with protractor (6) and retractor (7) muscles, by which the cartilage is moved backward and forward. The radula

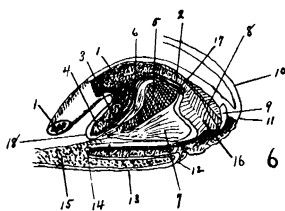


FIG. 7.

Buccal organs of *HELIX* (Guides for Science Teaching, Bost. Soc. Nat. Hist., VI., fig. 26). 1, oesophagus; 2, radula; 3, core of radula; 4, new teeth forming; 5, cartilaginous substance beneath the radula, serving for support and for the attachment of muscles; 6, posterior cartilage muscles; 7, anterior cartilage muscles; 8, cartilage bearing jaw; 9, jaw; 10, outer surface of mouth; 11, upper lip; 12, lower lip; 13, under surface of lip; 14, orifice of mucous glands; 15, mucous glands; 16, mouth; 17, cells lining under surface of radula; 18, radula sac.

(2) rests upon this cartilage, being strongly fastened at the anterior end, and is brought down between the two fleshy lips (11, 12) and there exerts a backward and forward movement, rasping off with its sharp teeth particles of food as they are

pressed against the top of the mouth. The horny jaws serve to cut the food into small pieces for the radula to act upon. The chitinous radula is constantly growing forward from the core or diverticulum (3) in the same manner that the human finger nail grows upon its bed, and ceases to grow as the anterior end is reached. As fast as the front end wears out from use it is replaced by fresh material from the core. A layer of cells lines the under surface of the radula which carries the latter forward.

The radula is a belt of chitinous, transparent, yellowish or colorless material, and its upper surface is beset with a large number of siliceous teeth, arranged in parallel rows (Fig. 8).



FIG. 8.

Two complete rows of teeth on the left side of a membrane of *POLYGYRA TRIDENTATA* Say (Binney & Bland, L. and F-W. Sh., fig. 220).

The portion of the radula nearest the mouth (anterior) is the most developed, and at the same time the most worn, while the posterior portion, or that part nearest the radula sac, is the least developed. The radula is usually divided into five longitudinal rows, each row differing from the one next to it. Thus we have a central row, on each side of this a lateral row, and on each side of this a marginal row (Fig. 9). Each tooth in each row is

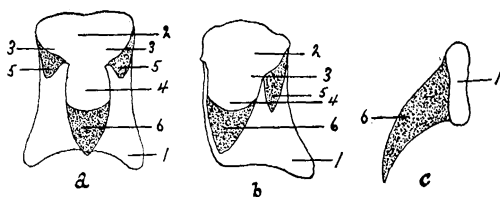


FIG. 9.

Diagram of teeth on the molluscan radula. a, median; b, lateral; c, uncinol or marginal. (Original.) 1., base of attachment to radula; 2., reflected portion; 3., side cusps; 4., median cusps; 5., cutting points of side cusps; 6., cutting point of median cusps.

made up of a number of different parts which, in their diversity, serve to distinguish the different groups of mollusks. Thus the central tooth has a strong, quadrate base of attachment (1) to



the radular belt; the rest of the tooth is reflected (2) and provided with three cusps, a median (4) and two lateral (3), and each cusp has a cutting point (5, 6). The lateral and marginal teeth may be divided in the same manner into cusps and cutting points (b, c). The lingual teeth of all pulmonate mollusks are divisible into two types (1), the quadrate (a) and (2) the aculeate (c). The latter has no reflected portion, but a single thorn-shaped cutting point arises from its sole-shaped base of attachment (Fig. 9, c, 1, 6).\*

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\*Those who desire a detailed account of the anatomy of the Molluscs may consult the following works:

Bronn and Keferstein: *Klassen und Ordnungen der Weichthiere*.

Tryon: *Structural and Systematic Conchology*.

Lankester: *Zoological Articles*.

Fischer: *Manual de Conchyliologie*.

## DESCRIPTION OF SPECIES.

NOTE.---The writer has not been able to make a satisfactory key to the genera for the reason that a number are founded upon anatomical characters.

### KEY TO FAMILIES IN THIS REPORT.

#### A. Shell bivalve.

- a. Shell large, pearly, lateral teeth placed posterior of cardinal teeth..... *Unionidæ*
- b. Shell small, not pearly, lateral teeth placed both anterior and posterior of cardinal teeth..... *Sphæriidæ*

#### B. Shell univalve.

- a. Inhabiting land and breathing air; tentacles invertible and eyes at their tips.
  1. Shell heliciform, smooth, shining.
    - \*Shell flat, concave, smooth and shining, but not vitreous, umbilicus very wide and deep ..... *Circinariidæ*
    - \*\*Shell flat to orbicular, smooth, shining and vitreous, umbilicus generally narrow..... *Zonitidæ*
  2. Shell heliciform, dull, generally coarsely ribbed.
    - \*Edge of aperture simple, sharp..... *Endodontidæ*
    - \*\*Edge of aperture reflected ..... *Helicidæ*
  3. Shells small, elongated aperture about one-third of length.
    - \*Aperture with teeth or folds+..... *Pupidæ*
    - \*\*Aperture without teeth ..... *Achatinidæ*
  4. Shell large, oval, aperture two-thirds of length..... *Succineidæ*
  5. Animal without external shell.
    - \*Mantle covering only pulmonary cavity, shell internal ..... *Limacidæ*
    - \*\*Mantle covering entire body, no shell..... *Philomycidæ*
  6. Animal with small, ear shaped shell placed at the posterior end of the body..... *Testacellidæ*
- b. Inhabiting land; tentacles contractile, but not invertible; eyes placed at their bases.
  1. Shell small columella with a fold, and parietal wall with one or two denticles..... *Auriculidæ*
- c. Inhabiting fresh water, but coming to the surface for air, which is necessary for respiration.
  1. Shell dextral; in one genus patelliform..... *Limnæidæ*
  2. Shell sinistral ..... *Physidæ*
- d. Inhabiting and breathing in fresh water; does not come to the surface for air.
  1. Shell large, spire very long and pointed; aperture about one-third of length ..... *Pleuroceridæ*

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+Excepting *Pupa fallax*, which has no teeth.

2. Shell large, globose; spire short and obtuse;  
aperture and spire about equal in length.....*Viviparidæ*
3. Shell small, variable in form.
  1. Shell globose or elongated.....*Amnicolidæ*
  2. Shell flat and discoidal.....*Valvatidæ*

## A. CLASS PELECYPODA.

"Aquatic, bilaterally symmetrical, acephalous mollusks, protected by a pair of shelly valves secreted by the lateral portions of the mantle, connected by a ligament, and moved by the contraction of muscles which connect the inner faces of the valves; feeding by ciliary action and destitute of a radula or jaw; breathing by lateral gills, the type of which is a midrib or stem, with a row of transversely oriented leaflets or filaments depending from each side of the stem, single, or mutually combined to form a direct or reflected plate; imperfectly sensible to light and rarely

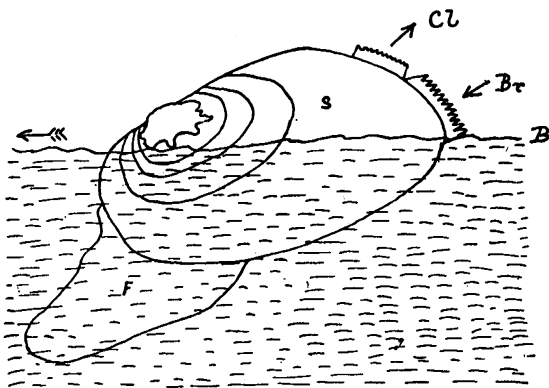


FIG. 9A.

Diagram showing position of UNIO while ploughing its way through the bottom of a lake or river. (After Morse.) cl, cloacal siphon; br, branchial siphon; f, foot; s, shell; b, surface of mud at bottom. <----- direction in which the animal is moving. ----->, currents of water to and from the gills.

provided with peripheral visual organs; possessing olfactory organs (osphradia), auditory and equilibrating organs (otocysts), tactile papillæ and a nervous system composed of (usually three principal pairs of) ganglia united by nerves, but without a pedovisceral commissure; provided with an extensive tactile or locomotor organ (foot); a closed, though partly lacunary, circulatory system, containing (usually colorless) hæmolymph, and operated by a single or paired cardiac ventricle and two auri-

cles; a more or less convoluted intestinal canal, with its oral and anal extremities at opposite ends of the body; a stomach; paired nephridia, connected with the pericardium, and discharging independently of the rectum; reproducing without copulation, by eggs and spermatozoa; monoecious or dioecious; development external to the ovary; the post-larval young protected by a prodissoconch, and sometimes exhibiting a nepionic stage; with a distribution in geological time from the Cambrian to the present day." (DALL.\*)

Fig. 9A shows the position of a fresh-water pelecypod in life, while ploughing its way through sandy or muddy bottoms.

### ORDER PRIONODESMACEA.

"Pelecypods having the lobes of the mantle generally separated, or, when caught together, with imperfectly developed siphons; the soft parts in general, diversely specialized for particular environments; the shell structure nacreous and prismatic, rarely porcellanous; the dorsal area amphidetic or obscure, rarely divided into lunule and escutcheon, and when so divided having an amphidetic ligament; ligament variable, rarely opisthodontic; armature of the hinge characterized by a repetition of similar teeth upon the hinge-line, or by amorphous schizodont dentition; habits active, sessile, or nestling, not burrowing; monoecious or dioecious." (DALL. \*)

### Superfamily Naiadacea.

"Shell of varied form, normally equivalve, inequilateral and dimyarian; rarely alate; shell substance nacreous and prismatic, with a conspicuous epidermis; area obscure or amphidetic; ligament parivincular, usually opisthodontic and external; ventricle embracing the rectum, with anterior and posterior aortas; gills reticulate, with direct and reflected laminæ, one or both pairs frequently utilized as a marsupium; pleural ganglia fused with the cerebral; otocyst impervious; pallial lobes usually free, except for an anal siphon; the pallial line simple; foot normally long, compressed, keeled, the byssus obsolete; anal end of rectum adherent; young usually with a distinct nepionic stage; station usually fluviatile." (DALL+. )

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\*Trans. Wagner Free Institute of Science, Vol. III., Part 3, p. 511, 1895.

+ Contr. to Tertiary Fauna of Florida, etc., Trans. Wagn. Free. Inst., Vol. III., Part 1, 1890

## FAMILY UNIONIDÆ.

The author is greatly indebted to Mr. Charles T. Simpson, of the United States National Museum, Washington, D. C., who has revised the manuscript of this family and has made many valuable suggestions regarding the classification and anatomy of the species and genera of the region covered by this work. In some groups Mr. Simpson has not fully worked out the anatomy and synonymy. In those cases where Mr. Simpson has described a genus or section, or has added notes regarding the anatomy, his name has been placed in parenthesis after such description or note.

"Shell usually equivalve and inequilateral, smooth or variously sculptured, angular or rounded, symphynote or nonsymphynote, covered with a thick epidermis, which may be green, brown, yellowish, black, rayed, or variously painted; *beaks usually sculptured* with concentric ridges, corrugations, chevron shaped or radiacal patterns, or pustules, *often showing remains of the nuclear shell*; ligament opisthodontic, well developed, external except when the shell is symphynote. Interior nacreous; with or without hinge teeth, *but showing vestiges of them in every genus*; when present *always schizodont and arranged as cardinals, laterals* (pseudocardinals and pseudolaterals), *or both*; adductor scars generally distinct, the anterior commonly impressed; pallial line simple and generally well marked; *prismatic border usually narrow and not conspicuous*.

"Animal: *Labial palpi almost always wider than long, having the upper parts of the posterior margins united; anal opening usually separated from the superanal*. Mantle either free or closed posteriorly to form a branchial opening. *Embryo a glochidium*, the soft parts being inclosed in a pouch shaped bivalve shell, either with or without hooks, and borne in the inner or outer, or in all four leaves of the branchiæ, which are modified to form a marsupium." \*

Of the 1,000 recent species of this family, over one-half inhabit the rivers and lakes of the United States. Like most fresh-water shells, the umbones of this group are nearly always eroded by the carbonic acid gas (CO<sub>2</sub>) which is dissolved in the water. The Anodontas are generally found in still bodies of water, on muddy bottoms, while the Unios prefer, as a rule, the bed of running streams. The Mississippi Valley is the metropolis of this interesting family of mollusks, and it is here that they are found in their greatest development, beauty and variety. The present area, with its numerous lakes and streams, affords an excellent locality for this group and the species found are

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\* Simpson, Classification of Pearly Fresh-water Mussels, p. 318.

generally large and finely developed. The beautiful development of the shells is due, probably, to the abundance of lime in this region. Geologically the family dates back to the Triassic Period.

Pearls are frequently found in our fresh-water bivalves (*Unio*) and are caused by some irritating substance which becomes lodged between the mantle and shell. These pearls are similar in structure to the shell, consisting of three layers. The beautiful iridescence is due to light falling on the edges of transparent plates. The nucleus of the pearl may be any foreign substance, like a grain of sand, piece of food particle or parasitic worm. Spherical pearls are frequently found loose in the soft parts of pelecypods, particularly in the muscles. The pearls of our fresh-water shells are usually of but little value.

Parasites commonly infest the Unionidæ, and *Aspidogaster conchicola* is found in colonies in the pericardium of *Unio* and *Anodonta*. Another species, *Cotylaspis insignis*, is found in the upper branchial cavity of *Anodonta*. *Unio* may also be considered a scavenger, since it feeds on dead animal matter whenever it is within reach.

It is not generally known that in the North American *Unionidæ* the genital organs may be divided into three groups. The first group includes such species as *ligamentinus* Lam., *rectus* Lam., *alatus* Say, etc., in which the posterior part of the *outer branchiæ* are used as "branchial uteri." In this group the females are readily distinguished by the dilated postero-ventral surface, and the uteri are filled with embryones from late summer to the beginning of or even through the winter, and in the early summer the embryones are discharged. In the second group all four branchiæ are used throughout as branchial uteri, and there is no striking differences between the sexes. Examples of this group are *pustulosus* Lea, *æsopus* Green and *undulatus* Barnes. In this group, also, the uteri are free from embryones during the fall from about August, and probably all winter. During the early summer the branchiæ are filled with embryones and are discharged some time during July.

In a third group, which has plain oval to elongated shells, the embryos are found in the outer gill alone, filling the whole or the greater part of the length of it. In this division may be placed the true *Unios*, the *Anodontas* and some smaller groups. Besides these three great sections there are several smaller ones

containing aberrant forms which are peculiar to North America.\*

The embryo of *Unio* is called a glochidium (Fig. 10) and as the latter is frequently found in the gills of *Anodonta* and *Unio*, it may be well to briefly outline the characters of the larva, that it may be identified when seen. It is quite important to record the date upon which specimens are seen with embryos in the branchial uterus, and also whether the outer or all four gills are used as a marsupium.

The young of the Unionidæ develop to a certain stage called, as above, the glochidium. After fertilization the mantle and shell develop rapidly, but the digestive organs are not developed until six months or a year afterward. When the embryo, or glochidium, leaves the parent it has the form shown in Fig. 10. It is encased in an egg shell (e) in which are

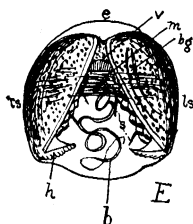


FIG. 10.

Anterior view of "Glochidium" of *ANODONTA*, enclosed in the eggshell, X100 (W. K. Brooks, Handbook of Inv. Zool., p. 330, fig. 174). b, byssus; bg, byssus organ; e, eggshell; h, hooks; ls, left valve of shell; m, posterior adductor muscle; rs, right valve of shell; s, setæ; v, velum.

enveloped the two *shells* (ls, rs) united by a stout hinge which is so elastic that the two valves are frequently seen in the same plane. The ventral edge of the shell forms a toothed hook or hooks, which are movable and from which the larva receives its name. The valves of the shell are lined by large spherical cells from some of which large *setæ* (s) project into the mantle cavity. There is a stout *adductor muscle* (m) and the space between the two sides of the mantle is filled by a long, elastic, brown, coiled, thread-like *byssus* (b) which is formed in the tub-

\*For further information the reader is referred to the most interesting articles (to which the author is indebted for the notes used) by Dr. V. Sterki, in "The Nautilus," Vol. IX. No. 8, p. 91 (November, 1895), and by Mr. Chas. T. Simpson in "The Nautilus," Vol. XI. No. 2, p. 18, June, 1897.

ular *byssus organ* (bg) situated in the left side of the mantle between it and the shell.\*

In this stage there are no auditory organs, gills or velum and the digestive cavity is a simple pouch with thick walls and a single large opening. The embryo of Anodonta reaches this stage in a few days after fertilization and remains in this stage without change until the following spring, when the parent discharges them through the cloacal siphon into the water. Here the embryos attach themselves by the byssus to the fins or gills of small fishes, close the valve of the shell onto the body of the fish by driving the hooks of the ventral surface of the valves into it. The fish covers the larva with a growth of epithelial cells and the embryo becomes encysted. Here it develops gills, oesophagus, stomach, intestine, renal organs and heart, and finally escapes from the cyst, falls to the bottom and completes its growth.+

\*   \*   \*

Ovules filling the entire outer gill of the female; ovisacs not separated by a sulcus. (Simpson.)

GENUS **ANODONTA** (Bruguière *Em*) Lamarck, 1799.

*Shell*: Generally thin, oval or oblong, inflated, without sculpture, anterior end evenly rounded, posterior dorsal region elevated or developed into a wing which meets the posterior end at a greater or less angle; epidermis generally smooth and nearly or quite destitute of rays; beaks concentrically sculptured; hinge line regularly curved, edentulous, *not incurved in front of the beaks*; nacre generally dull; muscle scars not impressed. (Simpson.)

*Animal*: Much like that of *Unio*, but the anal opening is always destitute of papillæ; outer gill of female when gravid enormously thickened and pad-like. (Simpson.)

*Distribution*: North America, Europe, Asia and North Africa, north of the Desert of Sahara.

#### KEY TO SPECIES OF ANODONTA.

A. Shell large.

1. Breadth generally moderate, compared with length; color dark green or blackish, more or less distinctly rayed; umbonal sculpture very coarse.....*grandis*

\*The byssus is sometimes retained after the mollusk is well on its way to maturity and such an organ has been found in *Unio ligamentinus* Lam., eight inches in length, the shell being 27 mill. long. The mollusk was found attached to a stone by the byssus. See Sterki, *The Nautilus*. Vol. V., p. 73.

+See Brooks, pp. 330-332.



2. Breadth generally great, compared with length; color light green or brownish horn, not generally distinctly rayed; umbonal sculpture fine; attains but two-thirds the size of 1 .....*footiana*

B. Shell small.

1. Elliptical or cylindrical, umbones flush with the hinge line; color greenish, with faint rays; very thin and fragile.....*imbecilis*

GROUP OF ANODONTA GRANDIS.

Shell large, inflated; umbonal region swollen beak; sculpture consisting of somewhat doubly-looped ridges which are often nodulous at the extremities of the loops. (Simpson.)

1. **Anodonta grandis** Say, pl. ii., pl. iii., fig. 1, pl. iv., fig. 1.

*Anodonta grandis* SAY, New Harmony Disseminator, Vol. II., No. 22, p. 341, 1829.

*Anodonta plana* LEA, Trans. Amer. Phil. Soc. 2d series, Vol. V., p. 48, pl. vii., fig. 18, 1834.

*Anodonta declivis* CONRAD, Amer. Journ. Sci. and Arts, 1st series, Vol. XXV., p. 341, pl. i., fig. 11, 1834.

*Anodonta salmonia* LEA, Trans. Amer. Phil. Soc., 2d series, Vol. VI., p. 45, pl. xiv., fig. 41, 1836.

*Anodonta decora* LEA, Trans. Amer. Phil. Soc., 2d series, Vol. VI., p. 64, pl. xx., fig. 63, 1836.

*Anodonta gigantea* LEA, Trans. Amer. Phil. Soc., 2d series. Vol. VI., p. 1, pl. i., fig. 1, 1838. (Variety, including the wide forms known as *p. lana*, *decora*, etc.)

*Anodonta ovata* LEA, Trans. Amer. Phil. Soc., 2d series, Vol. VI., p. 2, pl. ii., fig. 2, 1838.

*Anodonta harpethensis* LEA, Trans. Amer. Phil. Soc., 2d series, Vol. VIII., p. 224, pl. xix., fig. 42, 1840.

*Anodonta inornata* ANTHONY, American Journal of Conchology, Vol. II., p. 145, 1866. *Teste* LEA.\*

*Shell*: When adult, rather solid; when young, thin and fragile; elliptical, more or less inflated, well rounded before and triangular behind, the point of the triangle rounded; dorsal margin straight in the young but slightly curved in the adult, ventral margin generally straight, but sometimes very much rounded, posterior margin forming an ellipse in the male and a ram shape in the female; surface strongly marked by growth lines, which become elevated ridges as the shell increases in age; umbones not much elevated (generally), of a greenish golden or bronze color in the young, but becoming dark brownish or greenish with age, frequently eroded, and marked by five

\*Some of the synonymy adopted for the Unionidæ is taken from Prof. Call's work on Arkansas Unionidæ in Trans. Acad. Sci., St. Louis, Vol. VII., No. I, 1895.

strong, elevated, wavy wrinkles, which are arranged in two parallel rows, forming a double loop; ligament strong, dark horn color; epidermis variable in color, in the young it may be light greenish with faint indications of rays (sometimes stronger), while in the adult it is dark green, blackish or (rarely) reddish, with very faint diverging rays; umbonal slope rounded; hinge line slightly curved, a trifle thickened; adductor muscle scars and pallial line distinct but not impressed, iridescent; *protractor pedis* muscle scar distinct; dorsal muscle scars situated on the anterior face of the cavity of the beaks, deeply impressed and strongly striate; cavity of the beaks shallow, inflated; nacre silvery white in the young, but changing to purple in old specimens; iridescent.

Length,	128.00;	height,	71.00;	breadth,	52.00 mill.	♂ ( 9297).*
"	128.00;	"	74.00;	"	55.00	" ♂ ( 9528).
"	96.00;	"	48.00;	"	42.00	" ♂ ( 9528).
"	75.00;	"	48.00;	"	29.50	" ♂ ( 9842).
"	116.00;	"	67.00;	"	45.50	" ♀ ( 8419).
"	76.00;	"	46.00;	"	29.00	" — (12417).

*Animal:* Generally pinkish white, sometimes yellowish, spotted with blackish dots about the abdomen; liver brown; gills yellowish white; tentacular portion of mantle dark brownish black; labial palpi yellowish brown, not large, tongue-shaped, united only for a short distance along the dorsal margin; gills (*ctenidia*) large, the outer one smaller than the inner, united above throughout their entire length, rounded anteriorly and posteriorly; adductor muscles large and powerful; mantle transparent, somewhat vitreous; branchial and cloacal siphons large, the former lined with numerous dark brownish black tentacles, the latter plain. The pericardium, containing the heart, is situated somewhat toward the posterior end, and the pulsations are somewhat peculiar in some of the specimens examined; there is first a short, quick pulsation, followed immediately by a long, slow pulsation; the writer counted thirteen short and thirteen long pulsations, twenty-six in all. In several other specimens fifteen regular pulsations were counted. The latter is probably normal.

A curious little parasite belonging to the genus *Diplodontus* (family Hydrachnidæ) infests the mantle cavity of this species.

\*In measuring the pelecypods in this report the distance from the anterior to the posterior is called length, that from umbones to ventral border, height, and the diameter between the valves at their widest part, breadth. This differs from Dr. Lea's method, he calling the present height the length.

As many as half a dozen individuals have been found in a single *Anodonta*. (9668.)

*Distribution:* Western New York, west to Arkansas; British America south to Texas.

*Geological distribution:* Pleistocene.

*Habitat:* In lakes and rivers where there is little or no current. Prefers a muddy bed.

*Remarks:* The above description is drawn from a collection of over a hundred specimens from various localities. It is a very variable species, particularly in its corpulency, but may be distinguished from all other species found in this region by its large size and general dark green or black color. The peculiar undulate character of the umbones will also distinguish it from related species. This mud loving species is frequently found buried in the mud to the depth of eight inches or more. The young are somewhat alate, but lose this character as they mature. The rays are very variable; sometimes in the young shell they are very strong, grass green in color over a yellowish green background, and again appearing very faint on a dark green background. The specimens found in the northern region show more diversity of form than do those from the southern and western regions. In the former region the variation is from long and narrow to short and stumpy, in this respect approaching *A. footiana*.

On October 26, 1897, while the south pond in Lincoln Park was being cleaned, a colony of this species was found which surpassed anything hitherto found in the area in size and perfection. The epidermis was bright grass green, with fine, darker rays; the umbonal region was of a purplish or pink color, which in some examples reached far down the shell. The lines of growth on the larger specimens were very coarse and wrinkled about the margins of the shell. The larger specimens measured as follows:

Length, 171.00; height, 98.00; breadth, 68.00 mill.					
"	167.00;	"	100.00;	"	65.00 "
"	165.00;	"	96.00;	"	62.00 "
"	156.00;	"	95.00;	"	59.00 "
"	130.00;	"	75.00;	"	54.00 "
"	137.00;	"	71.00;	"	54.00 "
"	147.00;	"	89.00;	"	58.00 "
"	152.00;	"	78.00;	"	58.00 "

The specimens were found in a black, sticky mud, and were buried a foot beneath the surface.

A large number of specimens were dissected to ascertain if any tangible differences could be found in the shell between the sexes, but with a decided negative result. No differences could be found, excepting that the females were generally larger. A male and female of equal size gave the following measurements:

Length,	108.00;	height,	67.00;	width,	50.00 mill	♂
"	108.00;	"	65.00;	"	48.00 "	♀

In all the females the outer branchium only was used as a marsupium and this was of a dark brown color, very much swollen and so heavy that the least touch caused it to rupture. The glochidia were fully developed and very active, and seemed ready to be discharged into the water.

**2. *Anodonta footiana*** Lea, pl. iii., figs. 2, 3, 4; pl. iv., fig. 2; pl. viii., fig. 5.

*Anodonta footiana* LEA, Trans. Amer. Phil. Soc., 2d series, Vol. VIII., p. 225, pl. xx., fig. 44, 1843.

*Anodonta marryattana* LEA, l. c., Vol. VIII., p. 226, pl. xx., fig. 45, 1843.

*Anodonta opalina* ANTHONY, Amer. Journ. of Conch., Vol. I., p. 159, pl. xiv., fig. 2, 1865.

*Anodonta subangulata* ANTHONY, Amer. Journ. of Conch., Vol. I., p. 158, pl. xiii, fig. 1, 1865.

*Anodonta McNeilii* ANTHONY, Amer. Journ. of Conch., Vol. II., p. 144, pl. vi., fig. 1, 1866.

*Shell*: Thinner than *A. grandis*, much inflated, suboblong rounded before and triangular behind, the apex of the triangle truncated; dorsal margin straight; ventral margin straight or slightly rounded; posterior margin elliptical in the male and plough shaped in the female; surface marked with growth lines as in *grandis*; umbones not much elevated, light yellowish green in color, but generally eroded and pearly, and marked by four distinct, elevated, wavy wrinkles, arranged as in *grandis*, but very much finer; sometimes there is a fifth, very faint ridge; ligament strong, dark horn color; epidermis generally light greenish straw colored, varying to straw colored, horn or reddish, and generally without rays of any kind (sometimes very faintly rayed); umbonal slope very much rounded, owing to the greatly inflated umbonal region; hinge line very slightly curved, a trifle thickened; adductor muscle scars, *protractor pedis* muscle scar and pallial line distinct but not impressed; dorsal muscle scars as in *grandis*, small, slightly impressed; cavity of the beaks deep, inflated; nacre silvery white, iridescent, sometimes light mauve

or salmon colored. In some specimens the hinge line and edge of valve are mauve while the interior is salmon colored.

Length,	100.00;	height,	63.00;	breadth,	55.00 mill.	♂	(7165).
"	99.00;	"	55.00;	"	41.00	"	♂ (9299).
"	87.00;	"	48.00;	"	31.50	"	♀ (1693).
"	51.00;	"	32.00;	"	21.50	"	— (9844) Juvenile.

*Animal*: Not differing essentially from *Anodonta grandis*.

*Distribution*: Northern part of the United States and Canada. A species of the St. Lawrence drainage, but sometimes found in the Mississippi drainage.

*Geological distribution*: Pleistocene.

*Habitat*: Similar to that of *A. grandis*.

*Remarks*: The present species is very closely related to *A. grandis* and would, perhaps, be more correctly placed as a variety of that species. I am much opposed to the idea of varieties in this family, from the fact that it is difficult to find constant characters within the species. It seems to me that when tangible characters are present the form should rank as a species. The specimens before me show the following distinctive characters: In *footiana* the umbonal region is very much inflated and the anterior and posterior angles are very sharp; in *grandis* the umbonal region is more flattened and the angles are more gentle; in *footiana* the umbones have four fine, distinct wrinkles while in *grandis* there are five coarse ones; *footiana* is generally light green or brownish horn in color, while *grandis* is generally dark green or black. *Footiana* belongs to the St. Lawrence drainage, while *grandis* belongs to the Mississippi drainage. The two species frequently overlap, however, and there are many forms which are difficult to place. *Grandis* is by far the most common of the two species in this region. The specimens from Berry Lake (No. 7165) are unusually corpulent, those found at Winnetka (Nos. 9298-9299) being more typical.

#### GROUP OF ANODONTA IMBECILIS.

Shell rather thin, smooth, shining; umbonal region usually flattened, often rayed with delicately waved fine lines. (Simpson.)

### 3. *Anodonta imbecilis* Say, pl. v., fig. 1.

*Anodonta imbecilis* SAY, New Harm. Diss., Vol. II., No. 23, p. 355, 1829.

*Anodonta incerta* LEA, Trans. Amer. Phil. Soc., Vol. V., p. 45, pl. vi., fig. 16, 1832.

*Anodonta hordea* GOULD, Proc. Bost. Soc., N. H. Vol. V., p. 229; 1855.

*Shell:* Very thin and fragile, more or less elliptical, somewhat inflated, broadly rounded before and triangular behind, where it is much produced; dorsal margin obsoletely straight, ventral margin slightly rounded; surface smooth and shining, lines of growth very faint, excepting on the alate portion of the postern-dorsal margin and at the posterior end; here and there there is a black line *which* marks a heavier growth line than usual; umbones perfectly flush with the hinge line, brownish horn in color and marked by several concentrically arranged ridges of small size; the umbones are placed pretty well toward the anterior end; posterior slope subexcavated, anterior slope rounded; ligament thin and weak, light brown in color; epidermis bright grass green, brownish horn about the umbones, with numerous darker green rays extending to the ventral margin; hinge line simple and thin; muscle scars and pallial line rather faint; beaks without cavity; nacre silvery white, very iridescent.

Length, 59.00; height, 29.00; breadth, 21.00 mill. (12454).

" 50.00; " 26.00; " 18.00 " (12454).

" 41.00; " 22.00; " 12.00 " (12454). (Young.)

*Animal:* Anal opening small, outer rather large, with many brown papillæ; branchiæ slightly curved below, nearly equal in size, free nearly the whole length of the abdominal sac, marsupium occupying the whole of the outer gill. (Simpson.)

*Distribution:* Western New York to Arkansas, Canada to Texas and Louisiana.

*Geological distribution:* Pleistocene.

*Habitat:* Found on a muddy bottom in creeks, small rivers and ponds.

*Remarks:* This is one of the most beautiful and one of the most distinct of all Anodontas. Its beautiful grass green, fragile shell, so delicately rayed, its umbones flush with the hinge line and its peculiar shape at once distinguish it from all other forms. The young are frequently somewhat alate and some specimens are lighter in color than others, and they may be rayed or rayless. The only locality at present known is at Willow Springs, on the Desplaines River, where it is said to be quite abundant.

GENUS **ALASMODONTA** Say, 1819.

*Shell:* Solid rhomboid with a posterior ridge more or less biangulate behind, with a smooth, hard, shining epidermis, which is usually rayed; beak sculpture consisting of a few coarse

parallel ridges, which usually nearly follow the growth lines, but sometimes become somewhat double looped with fine radiating ridges behind the beaks and often in front of them; hinge teeth imperfect; one large, curved, compressed, irregular cardinal under the beak of the left valve which is often reflected upward, and a compressed, sometimes rudimentary tooth in front of it, the large tooth cutting off the hinge plate in the right valve; one cardinal in the right valve which falls between the two in the left valve; laterals blurred, generally having irregular ridges sloping back and downwardly on the hinge plate.

*Animal*: Much as in *Unio*; inner gill either wholly free from the abdominal sac or more or less united to it. Outer gill of female filled entirely with embryos when gravid; anal opening smooth or only slightly cornulate. (Simpson.)

#### KEY TO SPECIES OF ALASMODONTA.

A. Shell large.

a. Shell compressed.

1. Height nearly equal to length ..... *complanata*

2. Height about half of length ..... *rugosa*

3. Similar to 2, but lateral teeth well developed

and umbonal sculpture finer..... *pressa*

b. Shell inflated.

1. Breadth one-half of length..... *marginata*

B. Shell small, thick, quadrate..... *deltoidea*

#### GROUP OF ALASMODONTA RUGOSA.

**4. *Alasmodonta rugosa*** Barnes, pl, viii., figs. 3, 4, pl. vii., figs. 1, 2.

*Alasmodonta rugosa* BARNES, Amer. Journ. Sci. and Arts, 1st series, Vol. VI., p. 278, pl. xiii., figs. 21a, 21b, 1823.

*Shell*: Elliptical, rather thick, not inflated (the female is a trifle inflated), rounded before and obtusely angulated behind; dorsal margin straight, ventral margin straight in the male and curved in the female; umbonal slopes almost flat in the male and slightly rounded in the female; surface marked by heavy growth lines which form strong wrinkles on the dorsal part of the posterior angle; umbones neither elevated nor inflated, light brown in color, frequently eroded, and marked by three strong, almost straight, elevated ridges, the apex directed anteriorly; ligament long and narrow, dark horn color; epidermis yellowish green, delicately rayed with dark green; cardinal teeth thick and heavy, more or less pyramidal, striated on the upper surfaces; lateral teeth rudimentary, being little more than a thickening of the hinge plate; anterior adductor muscle scar very wide, deeply impressed, slightly striate and irides-

cent, confluent; posterior adductor muscle scar wide, not much impressed, confluent, iridescent; *protractor pedis* muscle scar wider than long, not much impressed; dorsal muscle scars situated on the posterior face of the cardinal teeth, pit-like; pallial line slightly impressed in the anterior part of the shell; cavity of the beaks shallow; nacre silvery bluish white, iridescent, salmon tinted toward the beaks. In old specimens the interior of the valve is bordered by a wide band (6-8 mill.) of dark purple or violet.

Length, 104.00; height, 57.00; width, 27.00; mill. ♂ (9333).

" 110.00; " 62.00; " 33.00; " ♀ (9524).

" 162.00; " 81.00; " 46.00; " ♂ (coll. Jensen).

*Animal*: Generally flesh colored or salmon, inclining to yellowish brown in places, yellowish white on abdomen and black on tentacular part of siphons; ctenidia short and wide, the inner one the largest, rounded before and pointed behind, united to each other and to the opposite pair for their entire length, the outer filled throughout with embryos in the female; labial palpi not large, rounded triangular, united and attached at base and partly above; siphons yellowish white inside, shading into brownish and jet black on the edge of the tentacular portion, the tentacles being short; foot thin, dark flesh color; liver brownish, tinged with yellow; mantle rather thin. Heart pulsations slow and regular -- thirteen per minute.

*Distribution*: Southern Canada south to Texas and Alabama, New England west to Kansas.

*Geological distribution*: Pleistocene.

*Habitat*: About the same as *A. complanata*.

*Remarks*: A species at once distinguished by its rugose posterior margin. *A. pressa* Lea has a general resemblance, and is frequently confounded with the present species by many conchologists, but the character of the umbones will at once distinguish the two species. See remarks under *pressa*. *A. rugosa* seems to be an abundant shell and is a lover of muddy rivers, at least in this region. It is found in great variety of form and size in Thorn Creek and the Little Calumet River. Specimens from the former locality are very rugose.

#### GROUP OF ALASMODONTA PRESSA.

#### 5. *Alasmodonta pressa* Lea, pl. vi., fig. 3; pl. x., fig. 4.

*Unio pressus* LEA, Proc. Amer. Phil. Soc., Vol. II., p. 237, 1843.

*Symphynota compressa* LEA, Trans. Amer. Phil. Soc., Vol. III., p. 450, pl. xii., fig. 22, 1830. (Preoccupied.)



*Shell*: Of good size, quadrangular, compressed, thin; rounded before and squarely truncated behind; dorsal margin straight, ventral margin slightly rounded; surface roughened by the lines of growth, which are more or less sharp and elevated on the borders; umbones small, very much depressed, compressed, reddish brown, marked by about six well developed, large, elevated, undulating ridges; anterior umbonal slope gently rounded, posterior slope rounded and slightly excavated; ligament short, wide, dark brown or black; epidermis reddish, corneous, yellowish or greenish, sometimes blackish, frequently covered with a deposit of foreign matter and rayed similar to *A. rugosa*; cardinal teeth double in both valves; in the left valve there is an elevated, rounded tooth just below the apex of the umbo, then a smaller, long and narrow tooth in front of this; in the right valve there is a very large, long and narrow tooth anterior to the umbo, and a very small, long and narrow thickening of the hinge line above this; sometimes, in very old specimens, there is a third prominent tooth between the two just mentioned in each valve; the cardinals are peculiar in being long, narrow, elevated and thin; they are smooth, or only very slightly roughened at their apices; lateral teeth weak, long, thin, lamelliform, smooth; there is frequently an indication of a second lateral in the right valve; anterior adductor muscle scar longer than wide, impressed, smooth; posterior adductor muscle scar not very distinct, confluent, diameters equal; *protractor pedis* muscle scar wider than long; slightly impressed; dorsal muscle scars scarcely visible, situated on the posterior face of the cardinal tooth; pallial line distinct, crenulated, impressed anteriorly; cavity of the beaks very shallow; nacre pearly white, very iridescent, inclining in some specimens to flesh color.

Length, 85.00; height, 50.00; breadth, 26.00 mill. (12311).

" 68.00; " 39.00; " 18.00 " (12411).

*Animal*: Generally dirty white, black on tentacular portion and edge of mantle; ctenidia large, rounded before and obtusely pointed behind, generally short and wide, attached above as in *A. rugosa*; labial palpi small, subtriangular, united at base and partly above; siphons dirty white inside, blackish on the edge; branchial opening large with papillæ; cloacal opening small without papillæ; foot thin, dirty white in color; mantle thin, somewhat thickened on the border. The whole outer branchium is occupied as an uterus.

*Distribution:* New York to Iowa, Michigan to Kentucky.

*Geological distribution:* Pleistocene.

*Habitat:* In creeks, buried in black, slimy mud to the depth of five or six inches. In this area it is found only in creeks, never in rivers or ponds.

*Remarks:* This species strongly resembles *Alasmodonta rugosa* Barnes, and is taken for that species by very many conchologists. In *pressa* the posterior margin is seldom roughened and the lateral teeth are generally more developed than in *rugosa*; the purple band on the edge of the valve in *rugosa* is absent in *pressa*. The characters of the cardinal teeth are very peculiar, and will at once distinguish this species. Specimens from Hickory Creek, where the species is abundant, have a yellowish epidermis beautifully rayed with deep grass green, and the umbones are distinctly marked. Just beneath the cardinal teeth, and posterior to the anterior muscle scar, the shell is thickened by a heavy deposit of shelly matter.

#### GROUP OF ALASMODONTA COMPLANATA.

**6. *Alasmodonta complanata*** Barnes, pl. viii., figs. 1, 2; pl. ix., figs. 1, 2, 3, 4.

*Alasmodonta complanata* BARNES, Amer. Jour. Sci. & Arts, 1st ed., Vol. VI., p. 278, pl. xiii., figs. 17a, 17b, 1823 (preoccupied by *Unio complanatus* Solander).

*Margaritana katherinæ* LEA, Synop. Far. Naid., 2d ed., 1839.

*Shell:* Very large and thick, heavy, subquadrate, alate, especially in the young; compressed in the male and inflated in the female; rounded before and triangulate behind; the angles straight; in the young shell this division is not so pronounced, the posterior border being broadly rounded; dorsal margin but slightly curved, ventral margin with a gentle curve in the male and a pronounced curve in the female; umbonal slopes almost flat in the male but strongly rounded in the female, the posterior slope a trifle excavated; surface marked by coarse lines of growth, which are generally raised into sharp ridges; umbones not elevated or inflated, light yellowish in color in the young, but changing into brown and black in old shells, and marked by four coarse, elevated ridges arranged in a double loop, the apex directed anteriorly; the umbones are frequently eroded; ligament very strong, long, narrow, dark brown or black in color; epidermis variable, yellowish brown marked by darker rays in the very young, changing to black or greenish, slightly rayed in the half grown forms, and deep reddish black or jet black in the

adult, the red color predominating in the region of the umbones; in some specimens the alate portion of the postero-dorsal portion is strongly wrinkled; cardinal teeth very thick, elevated, compressed, longer than wide, striated, two in the left and one in the right valve; a single female examined had a second rudimentary cardinal in the right valve; the posterior cardinal in the left valve is wider, thicker and more elevated than the anterior cardinal; lateral teeth represented by elevated ridges; that in the right valve is very thick and long and fits into a depression in the left valve, the ridges on each side corresponding to the lateral teeth in typical *Unio*; posterior adductor muscle scar excavated, striated, confluent, very wide; anterior adductor muscle scar oval, wide, not so much impressed, confluent; *protractor pedis* muscle scar very wide, impressed, striate; dorsal muscle scars small, very deeply excavated, situated on the posterior face of cardinal teeth; pallial line not much impressed; cavity of the beaks shallow; nacre silvery white with a bluish tinge, iridescent; in some specimens the whole shell inside of the pallial line is a deep salmon color.

Length, 135.00;	height, 96.00;	breadth, 39.00 mill.	♂ (9692).
" 150.00;	" 112.00;	" 48.00 "	♀ (From Milwaukee, Wis.)
" 108.00;	" 79.00;	" 28.00 "	♂ (9691).
" 45.00;	" 40.00;	" 12.00 "	juvenile (10086).
" 177.00;	" 132.00;	" 30.00 "	♂ (13438).
" 111.00;	" 76.00;	" 53.00 "	♀ (coll. Jensen).
" 120.00;	" 94.00;	" 33.00 "	♂ (13084).

*Animal*: Generally dark flesh color or salmon; ctenidia long and narrow, outer crowded throughout with ova in the female, half-moon shaped, rounded at both ends, scalloped on the ventral border, chocolate brown in color, united above and to the opposite pair for their entire length; labial palpi rather long, tongue shaped, color similar to the gills, united at base; foot large, thin, rich salmon color; the abdomen pale salmon or flesh color; siphons yellowish white inside, the tentacular portion brownish black; mantle whitish, edged with black or brownish; liver and cardiac pouch brownish.

*Distribution*: Mississippi and Ohio drainages; Great Lakes.

*Geological distribution*: Pleistocene.

*Habitat*: Found on a muddy bottom, generally in rivers, in water from knee to fifteen feet in depth.

*Remarks*: This is a very characteristic species, found generally in the larger rivers. It is at once distinguished from

all species by its squarish, heavy shell and peculiar, double looped umbonal sculpture, this last character being peculiar to the species. The female may be known by its more swollen shell, which is very much rounded on the ventral border. The very young shell (museum number 10086) shows the characteristic marking of the umbones better than the adult form. (Plate ix., fig. 4.) Pearls are frequently found in these species.

A single female specimen, from the Little Calumet River, was examined April 6, 1897. This specimen was very broad and extremely alate. In this specimen the entire outer gills were used as brood pouches, and the glochidia were very numerous and active, closing their delicate shells frequently with a sudden jerk. They treasured .30 mill. in length, and the byssus, adductor muscle and hooks on the valves were very much developed and conspicuous. There is a great difference between the male and female shells, so much so that they might easily be mistaken for different species. The Little Calumet River is the metropolis of this form, where it is largely and finely developed.

#### GROUP OF ALASMODONTA MARGINATA.

- 7. *Alasmodonta marginata*** Say, pl. iv., fig. 4; pl. vii., fig. 7; pl. xxii., fig. 3.  
*Anadonta marginata* SAY, Nich., Encycl., ed. 1, Vol. II, pl. iii, fig. 5.  
1816.

*Shell*: Smooth or slightly wrinkled, inflated, more or less quadrangular, rounded before and triangular behind, the apex truncated and placed near the ventral margin; dorsal margin curved, ventral margin straight or curved *inward*; umbonal slopes broadly rounded, the anterior angle short and the posterior angle long, wide and almost flat; surface marked by lines of growth which are raised in various places, especially on the posterior angle; umbones large, a trifle elevated, inflated, dark brown in color and marked by three very coarse, undulating, elevated ridges, and a single feeble one, each ridge forming two slightly curved loops, all directed anteriorly; ligament wide, not very long, very dark horn color; epidermis brownish or greenish, with wide darker rays, extending from the umbones to the ventral border, and dotted with black spots and dashes in various places; the rays are not so conspicuous in old specimens as in young ones; cardinal teeth not heavy, thin, elevated, striated, one in the right and two in the left valve; lateral teeth represented by a thickening of the hinge plate; anterior adduc-

tor muscle scar long, rather wide, deeply impressed, marked by lines of growth; posterior adductor muscle scar wide and spreading, not much impressed; *protractor pedis* muscle scar not heavily impressed, marked by lines of growth, wider than long, and connecting with the anterior adductor muscle scar without a break; dorsal muscle scars situated on the anterior face of the cardinal teeth and in the cavity of the beaks, large and deeply pitted; pallial line impressed; cavity of the beaks shallow; nacre bluish white, pearly, and iridescent on the edges of the valves.

Length, 75.00; height, 42.00; width, 34.00 mill. (7159).

" 61.00; " 37.00; " 25.00 " (7160).

" 54.00; " 28.00; " 20.00 " (7161).

*Animal:* Anal opening rather large, without papillæ; branchial opening very small, with delicate brown papillæ; palpi not united at posterior edges; branchiæ large, curved below, inner much larger, united to abdominal sac all the way or partly free. Outer gill of female occupied throughout with embryos. (Simpson.)

*Distribution:* Western New York west to Iowa, Michigan south to Louisiana.

*Geological distribution:* Pleistocene.

*Habitat:* In rivers and lakes, on a muddy bottom, in from two to fifteen or twenty feet of water.

*Remarks:* A species at once distinguished by its heavy, inflated shell and peculiarly marked unbones, the latter being larger in proportion to the size of the shell than in any species found in the region. In *marginata* the lower posterior angle is directed downward, or only very slightly turned up, and the whole posterior region appears truncated. The rays are sometimes very wide, dark green over a yellowish green background, and without the black spots. Apparently confined to the southern and western regions.

## 8. *Alasmodonta deltoidea* Lea, pl. vi., fig. 2; pl. vii., fig. 4.

*Margaritana deltoidea* LEA, Trans. Amer. Phil. Soc., 2 series, Vol. VI., p. 43, pl. xiii., fig. 38, 1836.

*Margaritana calceola* LEA, Trans. Amer. Phil. Soc., 2d series, Vol. VI., pp. 135, 143, 148, 1838.

*Shell:* Rather thick, not inflated, quadrate, compressed on the sides, rounded before and obtusely angular behind; dorsal and ventral margins straight; surface roughened by lines of

growth, which are raised into ridges on the ventral portion of the shell; umbones a little elevated, prominent, brownish in color and marked by four coarse, elevated ridges, the apex directed anteriorly; ligament short, narrow, very dark brown or chestnut in color; epidermis brownish, with numerous dark green rays of variable width extending from the beaks to the ventral border; cardinal teeth small, elevated, thick, striated, that in the right valve large, thick, longer than wide, that in the left valve smaller, narrow, saddle shaped; lateral teeth represented by a thickening of the hinge line; anterior adductor muscle scar long and narrow, deeply impressed, striated; posterior adductor muscle scar almost as wide as long, scarcely impressed, confluent; *protractor pedis* muscle scar small, long and narrow, impressed; dorsal muscle scars situated on the posterior face of the cardinal teeth, large, deeply impressed; pallial line distinct; cavity of the beaks shallow; nacre bluish, tinged with salmon or pinkish on the anterior portion, iridescent.

Length, 41.00; height, 23.50; breadth, 15.50 mill. (10085).

" 38.00; " 23.00; " 15.00 " (10085).

" 30.00; " 18.00; " 12.50 " (10092)

" 27.00; " 16.50. " 11.50 " (8364).

*Animal*: Yellowish white on foot, flesh colored on abdomen; mantle yellowish white edged with black; liver dark brown; ctenidia of medium size, rounded and united above for their entire length; labial palpi rather long, rounded, tongue shaped, narrow, flesh colored; siphons rather large, edged with black.

*Distribution*: Great Lakes and Mississippi Valley.

*Geological distribution*: Pleistocene.

*Habitat*: Found associated with *U. marginata*.

*Remarks*: After an examination of numerous specimens I am led to place *calceola* in the synonymy of *deltoidea*. They occupy the same localities and have the same general shape, and the description of one will answer as well for the other. In the female the shell is more produced posteriorly and also a little wider; there is a decided ridge where the umbonal slope meets the sides of the shell. This is a common little mollusk and one which is easily distinguished by its small size, solid shells and bright green rays. The umbonal markings are large and well developed. Old specimens become very solid, and the epidermis changes to almost black.

## KEY TO THE SPECIES OF UNIO.\*

- I. Shell generally thin, cardinal teeth but slightly developed, hinge line slightly thickened.
- a. Shell large, 45 mill, or more in length.
    1. Umbones large and coarsely wrinkled.
      - +Ground color of shell yellowish horn with dark green rays sometimes uniform dark brownish or blackish; posterior end broadly rounded, almost truncated.....*edentulus*
      - ++Ground color of shell greenish straw or light green with light green rays; posterior end acutely rounded. Umbones not so coarsely wrinkled as +.....*pavonius*
    2. Umbones small and finely wrinkled.
      - +Color light green or blackish horn, shell elliptical, posterior end broadly rounded ..... *ferussacianus*
      - ++Color yellowish horn, shell subcylindrical, posterior end acutely pointed.....*subcylindraceus*
  - b. Shell small, long and narrow, 35 mill, in length.....*hildrethianus*
- II. Shell generally solid, cardinal teeth well developed and hinge line with well developed lateral teeth.
- A. Shell smooth, with distinct rays.
1. Length 2½ times height.
    - a. Epidermis yellowish, plain or distinctly rayed with bright green, nacre white or pinkish .....*anodontoides*
    - b. Epidermis very dark green or black, rays faint, nacre rich purple.. .....*rectus*
  2. Length about twice height.
    - a. Shell large, inflated laterally, cylindrical, rays very narrow .....*luteolus*
    - b. Shell smaller and more pointed posteriorly than a; rays wide; shell much compressed.
      - +Rays interrupted forming square spots ..... *iris*
      - ++Rays not interrupted, continuous; larger and more solid than + .....*spatulatus*
  3. Length one-third greater than height.
    - a. Shell alate.
      - +Shell rather thin, lateral and cardinal teeth thin and weak; color light yellowish with fine green rays .....*gracilis*
      - ++Shell solid, lateral and cardinal teeth solid; color dark green or black with fine rays.....*alatus*
    - b. Shell not alate, rays in straight lines.
      - +Shell inflated.
        - \*Shell large, rays wide and few in number.... *ventricosus*

\*For the purpose of simplifying the work of determining the species of Unio, Strophitus, Anodontoides, Quadrula, Obliquaria, Plagiola and Lampsilis, the author has made a single key to contain all the species of these genera, thus doing away with the confusion which would follow the splitting up and placing of the key among these newly-recognized groups.





often reflected upward beneath the beak of the left valve, and one or two faint ridges in front of it on the right valve; laterals generally wanting.

*Animal*: Anal opening minutely papillose or crenulated; inner gill wholly or in part united to the abdominal sac; outer gill of the female filled when gravid with ovisacs *which run crosswise with it* and which probably empty through the outer wall of the gill. (Simpson.)

**9. *Strophitus edentulus* Say, pl. xii., figs. 3, 5, 6; pl. xvii., fig. 3.**

*Alasmodonta edentula* SAY, New Harmony Disseminator, Vol. II., No. 22, p. 340, 1829.

*Anodonta tetragona* LEA, Trans. Amer. Phil. Soc., 2d series, Vol. X., p. 82, pl. viii., fig. 25, 1845.

*Anodonta shafferiana* LEA, Trans. Amer. Phil. Soc., 2d series, Vol. X., p. 288, pl. xxvi., fig. 56, 1852.

*Anodonta arkansasensis* LEA, Trans. Amer. Phil. Soc., 2d series, Vol. X., p. 273, pl. xxix., fig. 56, 1852.

*Alasmodonta rhombica* ANTHONY, Amer. Journ. of Conch., Vol. I., p. 158, 1865.

*Anodonta annulata* SOWB, REEVE, Conch, Icon., Vol. xvii., *Anodon*, pl. xviii., fig. 67, 1869.

*Shell*: Rather solid, not much inflated, long-ovate or elliptical in form, rounded before and obtusely angled behind, dorsal margin slightly curved, ventral margin rounded; posterior margin obtusely rounded and posterior slope sometimes angulated; surface marked by strong lines of growth; umbones not much elevated, yellowish brown in color, eroded in adult specimens, and marked by three very large and coarse ridges, and one or two less conspicuous ones; the apex of the umbo is directed anteriorly; ligament strong, dark brown in color; epidermis light horn or yellowish brown with wide rays of dark green on the lighter background; the rays disappear in old specimens which become almost black; hinge line near the umbones reinforced by a tooth-like deposit which is a rudimentary cardinal tooth; adductor muscle scars, pallial line and *protractor pedis* muscle scar distinct but not impressed; dorsal muscle scars situated on the anterior face of the cavity of the beaks, the latter of medium depth; nacre bluish white, the cavity of the beaks and center of the shell, in some specimens, being strongly tinged with salmon; more or less iridescent.

Length, 68.00; height, 43.00; breadth, 26.00 mill. (8052).

" 48.00; " 28.00; " 19.00 " (9301).

" 76.00; " 44.00; " 29.00 " (coll. Jensen).

" 84.00; " 45.00; " 29.00 " (12413).

*Animal:* Generally brownish or yellowish brown in color, the mantle spotted with dark brown; ctenidia wide, not long, broadly rounded before and behind, united above and to the opposite pair throughout their entire length, brownish white in color; labial palpi of the usual shape, large, coarsely laminated inside, attached at base, dark yellowish brown in color on the inside, and light yellowish on the outside; foot large, dark flesh color shading into whitish on the abdomen; siphons yellowish white inside, changing to brownish and finally to black on the edge of the tentacular portion; anal opening minutely papillose; branchial with large papillæ; between the beaks and the pericardium the animal is pinkish. Heart pulsations regular, numbering ten to eleven per minute. The heart was seen beating for nearly half an hour after the animal was removed from the shell. The outer gill of the female is used as a marsupium and is filled with "ovisacs which run crosswise with the gill."

*Distribution:* Southern Canada, northern and central portions of the United States.

*Geological distribution:* Pleistocene.

*Habitat:* Found in the larger lakes and rivers, on a muddy bottom, in water from two to fifteen or more feet in depth.

*Remarks:* A widely distributed species, at once distinguished by the semidentate margin and coarse umbonal sculpture. When the interior is tinged with salmon it is one of our most beautiful shells. Some forms have the umbones a trifle elevated, and when in this state they greatly resemble some forms of *pavonius* (see remarks under that species). The rays are very variable and may be very distinct or hardly visible, and there is also considerable variability in width.

**10. *Strophitus pavonius* Lea, pl. iii., fig. 5; pl. v., fig. 3.**

*Anodonta pavonia* LEA, Trans. Amer. Phil. Soc., 2d series, Vol. VI., p. 78, pl. xxi., fig. 65, 1839.

*Anodonta wardiana* LEA, Trans. Amer. Phil. Soc., 2d series, Vol. VI., p. 46, pl. xiv., fig. 42, 1839.

*Shell:* Somewhat solid, a little inflated, elliptical, rounded before and acutely rounded behind; dorsal margin almost straight, ventral margin slightly rounded; surface smooth, marked by fine lines of growth; umbones elevated, inflated, light straw colored, marked by three strong elevated undulations, the apex directed anteriorly; ligament rather strong, dark horn-color; epidermis yellowish green, with light green rays extending from the umbones to the ventral margin; hinge line thick-

ened with a distinct cardinal tooth in each valve, anterior to the apex of the umbo; muscle scars and pallial line distinct but not impressed; dorsal muscle scars situated on the anterior face of the cavity of the beaks, deep and very distinct; cavity of the beaks rather deep; nacre bluish white, iridescent; in old specimens the interior of the shell is tinged with salmon.

Length, 69.00; height, 37.00; breadth, 28.00 mill. (coll. Jensen) .  
 " 49.00; " 28.00; " 20.00 " (12946).

*Animal*: Not differing essentially from *S. edentulus*.

*Distribution*: Mississippi and Ohio valleys; Great Lakes.

*Geological distribution*: Pleistocene.

*Habitat*: Similar to that of *S. edentulus*.

*Remarks*: This species may be distinguished from *edentulus* (which it greatly resembles, and of which it may be but a color variety) by the following points: The umbones are more inflated, and are situated nearer the center of the shell; the sculpture of the beaks is finer and less conspicuous; the ground color of the shell is greenish and the posterior end is acutely rounded. The cardinal tooth is also much more developed. In the young, the rays sometimes form broad bands of green. It is not at all impossible for the species to ultimately become a synonym of *S. edentulus*, as it is quite difficult to distinguish some forms of the two species. *Pavonius* is not common in the area under discussion.

GENUS **UNIO** Relzcius, 1788.

*Shell*: Oval to elongated, rather solid, generally having a more or less developed posterior ridge and becoming arcuate with age; epidermis mostly dull colored and soft, rarely rayed; beak sculpture consisting of a few coarse ridges, nearly parallel with the growth lines, sometimes a tendency toward being double looped or to break into nodules. Cardinals (pseudo-cardinals), two in the left valve and one (sometimes a small second tooth) in the right valve, laterals, two in the left and one (sometimes a small second tooth) in the right valve, laterals sometimes blurred or undeveloped, cavity of the beaks shallow.

*Animal*: Much like that of *Anodonta*, but generally having papillæ more or less developed on the anal opening. Embryos filling the entire outer gill of the female and forming a smooth, even pad, not so swollen as in *Anodonta*.

## GROUP OF UNIO GIBBOSUS.

**11. *Unio gibbosus*** Barnes, pl. xiv., figs. 3, 4; pl. xv., figs. 1, 2, 3, 4.

*Unio gibbosus* BARNES, Am. Journ. Sci. and Arts, 1st series, Vol. VI., pl. xi., fig. 12, 1823.

*Unio arctior* LEA, Trans. Am. Phil. Soc., Vol. VI., p. 10, pl. iv., fig. 10, 1834.

*Unio dilatatus* RAFINESQUE, Conrad in monograph, pl. xxi., 1838.

*Shell*: Of medium size, elongately elliptical, thick and heavy, compressed, rounded before and obtusely pointed behind; dorsal and ventral margins slightly curved or rounded; surface decidedly roughened by growth lines; umbones not elevated, compressed, yellowish brown, marked by five or six large wavy ridges; the umbones are directed anteriorly; anterior umbonal slope rounded; posterior slope rather flat, forming an angle with the sides of the shell; ligament long, rather wide, stout, dark horn or black; epidermis brownish or blackish, plain, sometimes reddish, and showing very light traces of rays; cardinal teeth small, double in both valves; the anterior tooth in the right valve very small, the posterior tooth elevated, triangular, thick, serrated, in the left valve equal, elevated, pyramidal, striated; lateral teeth long, lamellar, thick, serrated, sometimes tending to become double in the right valve; anterior adductor muscle scar large, deeply impressed, very strongly striated; posterior adductor muscle scar longer than wide, rather lightly impressed, concentrically striated; *protractor pedis* muscle scar wider than long, deeply impressed, striated; dorsal muscle scars situated below the hinge line posterior to the cardinal teeth, deeply impressed; pallial line impressed on the anterior part of the shell, crenulate; cavity of the beaks very shallow; nacre silvery white, salmon or purple, the purple being frequently confined to the center of the shell, below the hinge.

Length, 82.00; height, 36.00; breadth, 20.00 mill. ♂ (8423).

" 66.00; " 34.00; " 20.00 " ♀ (7388).

" 73.00; " 33.00; " 19.00 " ♂ (10087).

" 85.00; " 35.50; " 19.00 " ♂ (12412).

*Animal*: Yellowish brown in color, shading into creamy white; near the anterior part, the mantle edged with black, especially about the siphonal portion; anal opening of medium size with small papillæ; branchial opening larger with good sized papillæ; ctenidia long, rather wide, ends rounded, united above throughout their entire length, the outer ctenidium the smaller; labial palpi small, triangular, united at base, and

for nearly the whole length of the posterior margin; liver dark brown. Pulsations of the heart regular, twenty per minute. Another animal examined had but fourteen heart pulsations.

*Distribution:* Western New York to Minnesota and Kansas; south to Texas and east to Georgia. (Call.)

*Geological distribution:* Pleistocene.

*Habitat:* In muddy rivers, in from ten to fifteen feet of water.

*Remarks:* A common and widely distributed species, recognized by its dull brown shell. It varies greatly in its length, some specimens being short and stumpy, and others long and narrow, in this form much resembling *Lampsilis rectus*. The umbonal sculpture is very pronounced, and helps not a little to distinguish the species. In some specimens there are faint indications of dark rays, but the typical form is entirely rayless. The nacre varies from pinkish white to very deep purple, and in this state very much resembles *Lampsilis rectus*. It is widely distributed, being found in the northern, western and southern regions.

#### GROUP OF UNIO HILDRETHIANUS.

#### 12. *Unio hildrethianus* Lea\*, pl. v., fig. 4.

*Margaritana hildrethiana* LEA, Journ. Acad. Nat. Sci., Phil., Vol. IV., p. 49.

*Shell:* Small, long, compressed, thin, rounded before and broadly rounded behind; dorsal and ventral margins straight; surface smooth, the growth lines distinct and considerably elevated on the anterior parts; umbones small, prominent but not much elevated, dark brown in color and marked by three or four elevated wrinkles arranged in a double loop; ligament rather short and narrow, light horn color; epidermis yellowish, greenish or brownish, sometimes streaked with reddish brown, perfectly plain; cardinal teeth very small, thick, depressed; lateral teeth barely indicated by a thickening of the hinge line; muscle scars very broad, scarcely impressed, lightly striated; dorsal muscle scars very small, deep; pallial line a trifle impressed; cavity of the beaks very shallow; nacre bluish with a white patch on the anterior part, iridescent. There is a peculiar "bulge" extending from the umbones diagonally to the postero-ventral border.

Length, 41.50; height, 19.50; breadth, 12.50 mill. (12949).

" 38.00; " 18.00; " 11.00 " (12949).

♀  
♂

\*Mr. Simpson states that the generic position of this species is doubtful, and that it may take generic rank by itself; Mr. Simpson has been unable, as has also the author, to find specimens in a perfectly gravid condition.

*Animal:* Anal opening small, black, without papillæ; branchial opening rather large with crowded papillæ; mantle border decidedly thickened; inner gill larger in front, free from the abdominal sac a short distance posteriorly; gills not united to each other to the posterior extremity, but joined to the mantle to their posterior end. Outer gill contained a few ova in the specimens examined. (Simpson.)

*Distribution:* Great Lakes and Mississippi Valley.

*Geological distribution:* Pleistocene.

*Habitat:* In rivers and creeks, under stones and other objects. It is also found in mud which is free from debris.

*Remarks:* A small and characteristic species which is at once distinguished from all other species found in this region by its fragile shell, delicate hinge armature and minute beak sculpture. Next to *Lampsilis parvus*, it is the smallest species found in the region. The individuals from Hickory Creek are wonderfully uniform in shape and are readily identified by the peculiar swelling of the posterior part of the shell. This species also seems to be restricted to the Desplaines River and its tributaries, and is very abundant; when one is found, dozens or even hundreds of individuals may be found near by.

\* \* \*

Ovules filling the entire outer gill of the female, ovisacs short, running crosswise of the gill. (Simpson.)

GENUS **ANODONTOIDES**\* Simpson, 1898. New genus.

*Shell:* Elongate oval, inflated, thin, with a smooth, bright epidermis, which is often faintly rayed; beaks full, beak sculpture much as in *Strophitus*, but less developed and more delicate, consisting of a few concentric ridges with slight radiating ridges behind but not in front; hinge line slightly incurved in front of the beaks; teeth wanting or reduced to mere vestiges; nacre not brilliant.

*Animal:* Anal opening furnished with distinct papillæ; all four gills filled with embryos; inner branchiæ united, wholly or in part, with the abdominal sac. (Simpson.)

**13. *Anodontoides ferussacianus*** Lea, pl. iii., fig. 6; pl. v., fig. 2.

*Anodonta ferussaciana* LEA, Trans. Amer. Phil. Soc., 2d series, Vol. V., p. 45, pl. vi., fig. 15, 1837.

*Shell:* Rather thin, moderately inflated (much inflated pos-

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\*The writer used the name *Anodontopsis* for this genus in his mollusks of Western New York (Trans. Acad. Sci. St. Louis, Vol. VIII., p. 76); Mr. Simpson has since stated that the name was preoccupied by McCoy for a genus of fossil Pelecypoda, hence the change of the name as above.

teriorly in the female); elliptical, rounded before and obtusely angled, or rounded behind; dorsal margin straight, ventral margin rounded; surface marked by rather coarse lines of growth; umbones a trifle elevated, inflated, greenish gold in color when not eroded, and marked by three or four small, but well defined ridges directed anteriorly; anterior umbonal slope short and rounded; posterior slope long and somewhat flattened; ligament weak, light brown in color; epidermis light green, yellowish green or brownish, with numerous wide, dark green rays, extending from the umbones to the ventral margin; the umbones are not rayed; there is generally a dark brown line near the ventral border in the young, marking an old rest period; hinge line straight, feeble, only very slightly thickened, the cardinal teeth but slightly developed; muscle scars and pallial line very faint; cavity of the beaks shallow; nacre bluish white, iridescent.

Length,	56.00;	height,	32.50;	breadth,	21.00 mill.	♂	(9841).
"	55.00;	"	29.00;	"	21.00	"	♂ (9841).
"	71.00;	"	40.00;	"	27.00	"	♂ (8422).
"	81.00;	"	42.00;	"	40.00	"	♀ (coll. Jensen).
"	74.00;	"	39.00;	"	29.00	"	♂ " "

*Animal.* Generally light flesh color or white and transparent; ctenidia very wide but not very long, yellowish white, rounded at both ends, united above throughout their entire length; right and left pair not entirely united, leaving a space about half an inch, where they hang free; all four bronchiæ filled with ovules in the female; labial palpi wide, large, tongue shaped, dark flesh color with a patch of yellowish white on the dorsal margin, united at base; siphons thick, papillose variegated with cinnamon brown, the extreme border edged with black; mantle white and transparent, edged with black; liver dark brown; abdomen pearly white; foot large and muscular; heart pulsation regular, sixteen per minute.

*Distribution:* Mississippi River drainage and St. Lawrence drainage. New York west to Dakota, Southern Canada south to Texas.

*Geological distribution:* Pleistocene.

*Habitat:* Found commonly in lakes and rivers, on a muddy bottom.

*Remarks:* Distinguished from all other species found in this region by its grass green color, minute umbonal sculpture and delicate rays. It is found associated with *S. edentulus*, *A. grandis*, *A. pressus* and *L. luteolus*, all of which are mud loving

species. As the shell increases with age, the greenish epidermis is replaced by a brownish covering without rays. The females generally have a more inflated shell posteriorly than the male.

Mr. Simpson remarks as follows on gravid examples of this species which he has examined: "I found examples of *A. ferussaciana* in which all four of the gills were filled with embryos, the outer enormously distended, the inner moderately filled. I have found others in which only the outer gill was filled, and still others with the outer gill only partly filled. The inner gill may empty first or it may be filled only under favorable circumstances."

**14. *Anodontoides subcylindraceus* Lea, pl. iv., fig. 4; pl. vi., fig. 1.**

*Anodonta subcylindracea* LEA, Trans. Amer. Phil. Soc., 2d series, Vol.

VI., p. 106, pl. xxiv., fig. 117, 1839.

*Shell*: Somewhat thin, subcylindrical or elliptical, rounded before and triangulate behind, the apex of the angle truncated or rounded; dorsal and ventral margins nearly straight in the female, and ventral border rounded in the male; surface marked by distinct lines of growth, with several dark lines marking former rest periods; umbones but little elevated, rusty brown or greenish gold in color, but generally eroded, and with four small distinct elevated ridges, directed anteriorly; posterior slope almost flat, subangulated, but not much excavated; ligament rather short, narrow, dark horn color; epidermis greenish or greenish yellow, varying from plain to rayed, the green rays being numerous, rather wide, and radiating from the umbones to the ventral border; hinge line straight, a trifle thickened, with a bare indication of cardinal teeth anterior to the umbones; muscle scars and pallial line distinct but not impressed; cavity of the beaks shallow; nacre silvery white, with a shade of bluish, sometimes pure white under the beaks, iridescent.

Length, 69.00; height, 36.00; breadth, 26.00 mill. ♂ (12948).

" 63.00; " 32.00; " 24.50 " ♀ (coll. Jensen).

" 74.00; " 38.00; " 29.50 " ♂ (13032).

*Animal*: Generally whitish or yellowish; mantle white edged with brownish black, the tentacular portion darker; ctenidia long and narrow, rounded at both ends and united above their entire length, yellowish in color; labial palpi rounded, not large, united at base, yellowish in color; foot of good size, whitish or yellowish; the abdomen whitish; tentacles small, blackish



brown. The outer gills were distended with young April 12, 1897, and were of a deep chocolate color. Glacidia, as well as eggs in the morula stage, were very numerous, the former very active. Normally all four gills are used as marsupia.

*Distribution:* Illinois and Michigan to Ohio and western New York.

*Geological distribution:* Pleistocene.

*Habitat:* In small rivers and creeks, on a muddy bottom.

*Remarks:* This species may be distinguished from *A. ferussacianus*, with which it is very closely related and may be but a variety, by the greenish gold color of the umbones and its general cylindroid shape. The males are not so cylindrical as the females, and have the posterior end very pointed while in the female it is rounded. The species also varies in color, some being plain yellowish brown, while others are greenish yellow rayed with grass green. It is not as common as *ferussacianus*, and is found in the Desplaines River and its tributaries, the north branch of the Chicago River and Lake Michigan. Some forms are of a uniform yellowish horn color, without rays of any kind.

\* \* \*

Ovules filling all four gills of female, ovisacs not separated by a sulcus. (Simpson.)

#### GENUS **QUADRULA** Rafinesque, 1820.

*Shell:* Solid, triangular to rhomboidal with a well developed posterior ridge and generally dark or only feebly rayed epidermis, and in age often showing a tendency to become arcuate on the base; beaks high, usually curved forward, their sculpture consisting of a few rather heavy ridges, either nearly parallel with the growth lines or showing a tendency to fall into an anterior and posterior loop; hinge plate heavy, with the teeth arranged much as in *Plagiola*; cavity of the beaks deep and compressed; muscle scars well defined, anterior scar deep. There is often in this genus a decided lunule under and just in front of the beaks which is most conspicuous in the more solid, inflated forms.

*Animal:* Anal opening with only minute papillae or none; all four gills of the female being transformed throughout into marsupia when gravid; ovisacs not separated by a sulcus; inner gill generally free from the abdominal sac. (Simpson.)

## GROUP OF QUADRULA TRIGONA.

**15. *Quadrula trigona* Lea, pl. xv., fig. 5.**

*Unio trigonus* LEA, Trans. Amer. Phil. Soc., Vol. IV., p. 110, pl. xvi., fig. 40, 1831.

*Unio chunii* LEA, Jour. Phil. Acad., Vol. V., p. 196, pl. xxvii., fig. 265, 1862.

*Unio riddellii* LEA, Jour. Phil. Acad., Vol. V., pp. 197-8, pl. xxvii., fig. 267, 1862.

*Shell*: Trigonal, thick and heavy, much inflated, broadly rounded before and behind, the posterior margin being produced ventrally; dorsal margin curved, ventral margin more or less sinuous; surface more or less shining, roughened by lines of growth; umbones large, elevated, inflated, dark brown, directed anteriorly and unmarked except by growth lines; anterior umbonal slope short and flatly rounded, posterior slope strongly angled, with an excavation on each side of the angle which reaches from the apex to the ventral border, where it forms a decided beak-like projection; viewed anteriorly the shell is strongly heart shaped, resembling in this respect some *cardia*, particularly *Isocardia cor*; ligament short, wide, stout, very dark brown or black; epidermis reddish or blackish horn, unmarked by rays; cardinal teeth double in the left and single in the right valve, very stout, generally not much elevated, triangular, diverging, very deeply grooved and striated; lateral teeth short, solid, elevated, lamellar, serrated, directed and curved ventrally; the right lateral and the lower left lateral have each a depression and rudiment of an additional tooth; connecting bridge thick, wide, flat, smooth; anterior adductor muscle scar forming a truncated oval, very deeply excavated, striated; posterior adductor muscle scar oval, well impressed, striated; *protractor pedis* muscle scar wider than long, deeply impressed, striated; *retractor pedis* muscle scar oval, very deeply pitted, striated; dorsal muscle scars situated on the posterior face of the cardinal teeth and the under side of the connecting bridge, deep, large; pallial line impressed; cavity of the beaks deep; nacre silvery white, more or less iridescent.

Length, 47.00; height, 50.00; breadth, 40.00 mill. Mississippi River, Wis.

" 51.50; " 45.00; " 39.00 " " " "

" 60.00; " 43.00; " 30.00 " Calumet River (Hybrid ?).

*Animal*: Anal opening small, only slightly crenulated; branchial opening with stumpy brown papillæ; inner gill

larger, ashy salmon, free from the abdominal sac; all four gills moderately filled with embryos throughout. (Simpson.)

*Distribution:* "Western New York to Minnesota, and Iowa, and Kansas; to Texas, east to Mississippi and Tennessee." (Call.)

*Geological distribution:* Pleistocene.

*Habitat:* In the larger rivers, on a muddy bottom, in rather deep water.

*Remarks:* A very distinct species, at once recognized by its heavy trigonal form, elevated umbones and cordate appearance when viewed anteriorly. Specimens have been found fossil on an old lake beach, now half a mile from the lake, while digging foundations for new buildings. They were found at a depth of from five to ten feet below the surface. One specimen found while digging a cellar on Hall Street seems to be intermediate between *trigona* and *rubiginosa*; it has the length and height of *rubiginosa* and the trigonal and inflated shape of *trigona*. The cardinal teeth are more elevated and deeply sulcated in some specimens than in others, and some forms are longer in proportion to their height. So far as known it is found only in the Calumet River, in which stream Messrs. T. Jensen and H. B. Derr found each a single dead specimen. The individual collected by Mr. Derr seems to be a cross between *rubiginosa* and *trigona*, having the length and general shape of the former and the inflated and elevated umbones of the latter.

**16. *Quadrula rubiginosa* Lea, pl. xix., fig. 2; pl. xx., fig. 1.**

*Unio rubiginosus* LEA, Trans. Amer. Phil. Soc., Vol. III., p. 409, pl. viii., fig. 10, 1829.

*Unio flavus* RAFINESQUE, Conrad in monograph, p. 74, pl. xli., fig. 2, 1837.

*Shell:* Elliptical or quadrate, rather thick, compressed, sometimes constricted in the center of the shell, incrassate, rounded before, squarely truncated behind; dorsal border slightly curved; ventral border straight or curved; surface roughened by lines of growth, which are elevated into sharp ridges; umbones a trifle elevated, inflated, light yellowish brown, marked by five or six heavy, elevated, rounded ridges; anterior umbonal slope rounded; posterior slope angulated, excavated in some specimens; ligament short, wide, solid, very dark brown; epidermis dark horn colored or yellowish, darker in old specimens, and with very faint indications of rays in young specimens; cardinal teeth double in both valves, about

equal in the left valve, and the anterior tooth small and rudimentary in the right, all stout, heavy, a trifle elevated, triangular, very heavily sulcated; lateral teeth long, wide, thick, heavy, pyramidal when studied in cross-section, serrated, directed toward the ventral margin; connecting plate between cardinal and lateral teeth flat, thick, not much spreading; anterior adductor muscle scar mussel shaped, very deeply excavated, concentrically and longitudinally striated; posterior adductor muscle scar rounded, impressed, concentrically striated; *protractor pedis* muscle scar wider than long, deeply impressed, striated; dorsal muscle scars situated on the posterior face of the cardinal teeth, deeply impressed; pallial line crenulated, impressed; cavity of the beaks deep; nacre silvery white with a tinge of salmon near the cavity of the beaks, and on the anterior part, iridescent.

Length, 64.00; height, 45.00; breadth, 27.00 mill. (8369).

" 69.00; " 49.00; " 30.50 " (7764).

" 40.00; " 30.00; " 22.50 " (7764).

" 79.00; " 60.00; " 33.00 " (13441).

*Animal:* Generally brownish slate color, except on the foot which is dark flesh or salmon; ctenidia short and wide, rounded before and behind, united above, and to the opposite pair, throughout their entire length, the inner one the larger; color of ctenidia bluish; labial palpi tongue shaped, united at base and for a short distance posteriorly; foot very thick; siphonal openings brownish, the anal small and almost smooth; the branchial larger, with dark flesh or salmon colored papillæ; edge of mantle brown; liver yellowish brown; between the beaks and the pericardium the animal is bluish white. The abdomen is of a beautiful pearl color, and the mantle is sometimes pink or salmon colored. Four gills used as marsupia.

*Distribution:* New York west to Iowa, Michigan south to Louisiana and Alabama.

*Geological distribution:* Pleistocene.

*Habitat:* Found rather plentifully in the larger rivers, on a muddy bottom, in water from a foot to twenty feet or more in depth.

*Remarks:* A species showing considerable variation, especially in the shape of the posterior portion, and in its corpulency. It is always dark colored. Some specimens approach very closely to *trigona*. The form is also confounded, by many conchologists, with *coccinea*, but that species is more rounded and

lacks the angulate character of the posterior slope; the cardinal teeth also present some differences, being more massive and diverging in *coccinea* than in the present species. The plate of the lateral teeth is also broader in *coccinea*. Specimens examined June 2, 1897, had both gills filled with embryos.

**17. *Quadrula coccinea*** Lea, pl. xiv., fig. 1; pl. xix., fig. 3.

*Unio coccineus* LEA, Trans. Amer. Phil. Soc., Vol. VI., p. 12, pl. v., fig. 12, 1834.

*Unio gouldii (gouldianus)* LEA, Trans. Amer. Phil. Soc., Vol. X., p. 76, pl. vi., fig. 16, 1845.

*Shell*: Roundly quadrate, or roundly elliptical, somewhat compressed, thick and solid; rounded before, squarely truncated behind, sometimes much produced; dorsal and ventral borders curved; surface roughened by growth lines which are more or less sharp and elevated; umbones elevated, rather compressed, reddish brown, marked by three large, elevated, undulating wrinkles and numerous fine growth lines; anterior umbonal slope rounded, posterior slope flat, subangulated, and sometimes excavated; ligament short, wide, strong, very dark brown or horn; epidermis brownish or reddish brown, shining; cardinal teeth double in both valves, nearly equal in the left, the anterior tooth but a rudiment in the right valve, all depressed, triangular, thick, heavy, strongly serrated, the anterior tooth in the left valve being long and narrow; lateral teeth rather long, elevated, lamellar, serrated, directed ventrally; the single lateral in the right valve has a depression into which the ventral tooth in the left valve fits; connecting plate between the teeth wide and spreading, thin, flat, smooth; anterior adductor muscle scar a little longer than wide, deeply excavated, rounded below, truncated above, striated; posterior adductor muscle scar roundly quadrate, slightly impressed, striate, confluent; *protractor pedis* muscle scar wider than long, very deeply excavated, striated; dorsal muscle scars situated on the posterior face of the posterior cardinal tooth in the left valve very deep, long and narrow; cavity of the beaks shallow; pallial line barely visible; nacre rose, pink or salmon pink, iridescent; in some specimens the nacre is white.

Length, 52.50; height, 39.50; breadth, 20.00 mill. (10088).

"	61.00;	"	56.00;	"	33.00	"	(12992). Hybrid.
"	71.00;	"	50.00;	"	28.00	"	(12944).
"	66.00;	"	54.00;	"	32.00	"	(12944).

*Animal*: Generally a delicate flesh color, shading to bluish

white about the adductor muscles and a part of the foot and abdomen, which latter is yellowish; ctenidia short and wide, rounded before and behind, united above and to the opposite pair throughout their entire length; labial palpi triangular, yellowish at base and bluish white at tip, united at base and partly on the posterior side; foot large, flesh colored; siphonal openings yellowish inside shading to brownish; anal opening slightly crenelated, small; branchial with numerous brownish or blackish papillæ; edge of mantle black; liver dark brown. Four gills used as marsupia.

*Distribution:* Mississippi and Ohio valleys.

*Geological distribution:* Pleistocene.

*Habitat:* In rivers, in soft, black mud.

*Remarks:* This species is closely related to *Q. rubiginosa*, but may be distinguished by its inflated umbones, roundly elliptical shell, produced postern-ventral margin and its heavy cardinal teeth. In some specimens the pink nacre serves as a distinguishing character, but only about thirty per cent are thus colored, the others having a white nacre. The young more nearly resemble *rubiginosa*, but as they become older the characters of *coccinea* become more pronounced. In the DuPage River a form is sparingly found, which Prof. R. E. Call says is a cross between this species and either *trigona* or *rubiginosa*. As *rubiginosa* is the only other form of this group found in the DuPage River, the cross must be between these two species. The cross has a thicker and more quadrate shell than the typical form. This is a very significant fact, which may account for much of the perplexity attending the identification of the Unionidæ. The species seems to be confined to the Desplaines River drainage.

#### GROUP OF QUADRULA PLICATA.

**18. *Quadrula plicata*** Lesueur, pl. xxvi., fig. 1.

*Unio plicatus* LESUEUR, Lea, Trans. Amer. Phil. Soc., Vol. III., p. 409, 1829.

*Unio rariplicata* LAMARCK, Animaux sans vertebres, ed. 1818, Vol. VI., p. 71.

*Unio hippopæus* LEA, Trans. Amer. Phil. Soc., 2d series, Vol. X., p 67, pl. i., fig. 1, 1845.

*Shell:* Broadly elliptical, plicate, very thick and solid, inflated, rounded before and quadrate behind; dorsal and ventral borders almost straight; surface heavily marked by growth lines and by from four to six rather heavy plications which extend in a diagonal direction across the shell, passing

from the upper part of the shell toward the ventral part; umbones large, elevated, inflated, dark horn color, marked by about five fine, diverging wrinkles; anterior umbonal slope rounded, short; posterior slope long, obtusely angular, excavated; ligament long, wide, stout, very dark brown or horn color; epidermis black or reddish brown; cardinal teeth double in both valves, the anterior smallest in both valves, but that in the right valve much smaller; all depressed, stout, triangular, very deeply grooved and channeled; lateral teeth long, stout, thick, elevated, serrated, directed ventrally; connecting plate thick, wide, smooth; anterior adductor muscle scar kidney shaped, very deeply impressed, very strongly marked by elevated ridges; posterior adductor muscle scar truncated-oval, distinct but not much impressed, striated; *protractor pedis* muscle scar wider than long, very deeply excavated, striated and strongly pitted; dorsal muscle scars large, very deeply impressed, one in each valve situated on the under side of the connecting bridge; pallial line crenulated, impressed; cavity of the beaks deep; nacre silvery white, pearly on the posterior portion.

Length, 79.00; height, 64.00; breadth, 50.00 mill. (coll. Handwerk).  
 " 80.00; " 63.00; " 52.00 " (13003).

*Animal:* Anal opening very large, only slightly crenulated; branchial opening very large with many small papilla; palpi long and falcate, united above and behind; gills large, inner much the larger, free from the greater part of the abdominal sac; not gravid. (Simpson.)

*Distribution:* Western New York to Arkansas and Iowa, Michigan to Alabama and Texas.

*Geological distribution:* Pleistocene.

*Habitat:* In the larger rivers, in rather deep water, generally on a muddy bottom.

*Remarks:* *Plicata* is generally confounded with *undulata* Barnes, but there is no good reason for this, as they are quite distinct and easily separated. *Plicata* is always strongly inflated at the umbones, which are much elevated, and the shell is generally broader than *undulata*. The undulations are fewer in the present species and are differently arranged. In *undulata* the umbones are flat and depressed, and the whole shell is compressed. The cardinal teeth are proportionately heavier in the present species. It does not seem to be very common in this area, and is confined to the lower part of the Desplaines River.

**19. *Quadrula undulata*** Barnes, pl. xxii., fig. 1, 2; pl. xii., fig. 1.

*Unio undulatus* BARNES, Am. Jour. of Sci. and Arts, 1st series, Vol. VI., p. 120, fig. 2, 1823.

*Unio costatus* RAFINESQUE, Conrad, Monograph of Unio, p. 17, pl. vii., 1836.

*Unio latecostatus* LEA, Trans. Am. Phil. Soc., Vol. X., p. 68, pl. i., fig. 2, 1845.

*Unio pilsbryi* MARSH, The Nautilus, Vol. V., p. 1, 1891; Vol. VII., pl. i., figs. 7, 8, 1893 (vide Call).

*Shell*: Quadrately elliptical, undulate, compressed, very thick and heavy, rounded before and obtusely triangular behind; dorsal margin straight, ventral margin slightly rounded; surface roughened by lines of growth which are raised into thin scales on the ventral border; umbones not elevated, somewhat inflated, brownish horn color, marked by five coarse, diverging, rounded ridges; anterior umbonal slope short, rounded; posterior slope long, flatly rounded; ligament long, narrow, thick, reddish or blackish horn color; epidermis reddish brown or blackish; the whole surface of the shell is marked by coarse undulations extending in a diagonal direction across the surface, in most specimens bifurcating; five or six large undulations are generally present with several smaller ones; cardinal teeth double in both valves, about equal in the left, and the anterior much the smaller in the right valve, all but the latter heavy, thick, triangular, diverging, very deeply striated and grooved; lateral teeth long, thick, more or less elevated, slightly curved ventrally, serrated; connecting plate between the teeth thick, flat, smooth; adductor muscles and *protractor pedis* scar as in *plicata* dorsal muscle scars numerous, of good size, deeply pitted, situated on the posterior face of the cardinal tooth and on the under side of the connecting plate; pallial line very deeply impressed, crenulated; cavity of the beaks broad, shallow; nacre silvery white, iridescent on the posterior portion.

Length, 131.00; height, 88.00; breadth, 52.00 mill. (9321).

" 86.00; " 65.00; " 33.00 " (9347).

" 83.00; " 60.00; " 31.50 " (9526).

" 150.00; " 108.00; " 60.00 " (coll. Jensen)

*Animal*: Creamy white, light brown on abdomen and upper portions; anal and branchial openings large, the former slightly crenulated and the latter with numerous small papillæ; posterior part of mantle yellowish brown, edged with black, especially near the two siphons; liver darker in color than the



abdomen; ctenidia short and wide, rather pointed behind, rounded before, the inner ctenidium the larger, united above throughout their entire length; labial palpi large, elongately oval or tongue shaped, united as is usual in this genus; foot large and muscular; pulsations of the heart very regular, eleven to twelve per minute. Four gills used as marsupia.

*Distribution:* New York and Georgia west to Kansas and Dakota, Michigan south to Texas.

*Geological distribution:* Pleistocene.

*Habitat:* Same as that of *Unio gibbosus*.

*Remarks:* The writer has noted the principal differences between this species and *plicata* under the latter species. There was considerable variation among the specimens of this species examined. The second cardinal in the right valve may be almost half as large as the posterior cardinal or it may be absent; there is also every degree of undulation, from a condition almost smooth (9347) to one in which the ridges are large and finely developed. *Unio pilsbryi* Marsh seems to be founded on one of these variations. This is a rather common species and is widely distributed, being found in most parts of the area. It has been found fossil in a cellar dug on the corner of Frederick and North Clark Streets, about half a mile from the present lake shore. Very large and fine specimens weighing 1 lb. 10 oz. have been collected by Mr. Jensen in the Little Calumet River. The specimens from this locality are very rugose and show a tendency toward *Q. multiplicata*.

#### GROUP OF QUADRULA LACHRYMOSA.

#### 20. *Quadrula lachrymosa* Lea, pl. xxiv., fig 1; pl. xii., fig. 2.

*Unio lachrymosus* LEA, Trans. Amer. Phil. Soc., Vol. III., p. 272, pl. vi., fig. 8, 1827.

*Unio asperrimus* LEA, Trans. Amer. Phil. Soc., Vol. IV., p. 71, pl. v., fig. 3, 1830-1.

*Unio quadratus*, RAFINESQUE, Say, Amer. Conch., pl. lii., 1834.

*Unio lunulatus* PRATT, Proc. Davenport Acad. Sci., Vol. I., pl. xxxi., fig. 1, 1870.

*Shell:* Quadrate, compressed, solid and heavy, pustulose; rounded before and squarely truncated behind; dorsal margin straight or slightly curved; ventral portion with an excavation near the posterior end; surface roughened by growth lines and covered with pustules which are arranged in two series on either side of a smooth depression situated in the center of the shell, and extending from the umbones to the ventral border, at the

excavation spoken of above; the anterior set of pustules is arranged in a narrow line, but the posterior set covers all of the posterior part where they are long and narrow and directed toward the posterior border; the majority of the pustules are small and rounded, but there are one or two very large ones near the ventral and central part which are longer than wide; the pustules are more numerous about the umbonal region than on any other part of the shell and the anterior part of the shell is always free from them; umbones small, compressed, light brown, marked by numerous small pustules; anterior umbonal slope rounded, posterior slope pustulose, forming an angle; ligament short, wide, solid, very dark brown; epidermis yellowish green, obscurely rayed with dark green; cardinal teeth stout, triangular, diverging, heavily grooved, double in both valves as in *reflexa*; lateral teeth long, narrow, serrated, directed ventrally; connecting bridge solid, flat, smooth; anterior adductor muscle scar forming a truncated oval, deeply impressed, striated; posterior adductor muscle scar scarcely visible, confluent; *protractor pedis* muscle scar oval, deeply impressed, striated; dorsal muscle scars numerous, small (large exceptionally), deeply pitted, situated on the posterior face of the cardinal teeth and on the under side of the connecting bridge; pallial line impressed, especially anteriorly, crenulated; cavity of the beaks deep; nacre silvery white, iridescent, especially on the posterior part of the shell.

Length, 60.00; height, 47.00; breadth, 28.00 mill. (9696).

" 68.00; " 53.50; " 25.00 " (13088).

" 86.00; " 70.00; " 39.00 " (13442) .

" 30.00; " 21.00; " 13.00 " (13442 juv.)

*Animal:* Pearly white, tinged with flesh color; ctenidia small, long and somewhat narrow, rounded at both ends, the inner one the larger, united above for their entire length, but the opposite pair united to its fellow pair for but three-quarters of the distance; color of gills light flesh; labial palpi of same color as gills, large and wide, tongue shaped, united at base; foot rather large, flesh colored; abdomen pearl colored, tinged with flesh, sometimes iridescent; mantle pearly or flesh colored, with a line of pearl colored vertical fibers running clear around near the border; the ventral border edged with brown; anal and branchial openings large, brownish, the former crenulated and the latter papillose; liver brownish; heart very active and

regular, pulsations thirty-one to thirty-three per minute. Four gills used as marsupia.

*Distribution:* Western New York to Kansas and Minnesota, and south to Texas and Alabama. (Call.)

*Geological distribution:* Pleistocene.

*Habitat:* Found in the larger lakes and rivers, on a muddy or sandy bottom, in somewhat shallow water.

*Remarks:* This is a characteristic and somewhat rare species in this area, and it is one of our most beautiful Unios. The pustulate character of the posterior margin is quite unique, some of the larger pustules being shaped like the nodules in *Obliquaria reflexa*. So far as known, it is confined to the southern region, and the specimens are of medium size, yellowish green faintly rayed with grass green. In old specimens the shell becomes a dark chestnut brown.

#### GROUP OF QUADRULA PUSTULOSA.

##### 21. *Quadrula verrucosa* Barnes, pl. xxiii.

*Unio verrucosus* BARNES, Amer. Journ. Sci. and Art, 1st series, Vol. VI., p. 123, fig. 6, 1823.

*Shell:* Ovately quadrate, thick, heavy, pustulate, compressed, rounded before and squarely truncated behind; dorsal margin nearly straight, ventral margin generally rounded but sometimes nearly straight; surface strongly roughened by growth lines and profusely covered with tubercles and pustules on all but the anterior portion, the pustules being wider than long and following the direction of the growth lines; the pustules are more numerous in the center of the shell than elsewhere; umbones small, prominent but not elevated, somewhat inflated, strongly directed anteriorly, brown in color, marked by numerous heavy, wavy ridges, which extend for a considerable distance toward the ventral part of the umbonal slope; anterior umbonal slope rounded, posterior flat, somewhat alate, or slightly excavated, forming a shoulder; ligament long, wide, stout, very dark horn color; epidermis uniform dark brown; cardinal teeth single in the right and double in the left (there is almost always a very small tooth-like projection in the right valve, near the lunule, which is without doubt a rudimentary second cardinal), flattened, large, solid, triangular, deeply grooved, diverging in the left valve; lateral teeth short, very strong, striated, directed ventrally; connecting bridge broad, flat, smooth and solid; the shell extends above and posterior to

the lateral teeth and forms a flat, alate projection; anterior adductor muscle scar oval, deeply excavated, heavily striated; posterior adductor muscle scar rounded, slightly impressed, striated, confluent; *protractor pedis* muscle scar wider than long, very deeply excavated, striated; dorsal muscle scars situated on the posterior face of the cardinal teeth, under the connecting bridge, numerous, rounded, deeply pitted; pallial line deeply impressed anteriorly, crenulated; cavity of the beaks deep; nacre varying between mauve and purple, iridescent on the posterior portion, having a satin finish near the cavity of the beaks.

**Length, 83.00; height, 66.00; breadth, 35.00 mill.** ♀ (8090).

" 64.50; " 58.00; " 27.00 " ♂ (8090).

*Animal*: Anal opening small with no papillæ; branchial opening very large, with many small brown papillæ; palpi sub-triangular, united one-half way posteriorly; branchiæ not large, nearly semicircular, inner one the larger, free nearly two-thirds of the length of the abdominal sac; marsupia not developed. (Simpson.)

*Distribution*: Found generally throughout the Mississippi Valley and in the Ohio Valley.

*Geological distribution*: Pleistocene.

*Habitat*: Found plentifully in the larger lakes and rivers, on a muddy bottom.

*Remarks*: A characteristic species which bears no particular resemblance to any other mollusk found in the area. It is confined to the southern region, where it is found of large size and fine coloration.

**22. *Quadrula pustulosa*** Lea, pl. xxiv., fig. 2; pl. xxv. ; pl. xxvii., fig. 13.

*Unio pustulosus* LEA, Trans. Amer. Phil. Soc., Vol. IV., p. 64, pl. viii., fig. 7, 1830.

*Unio schoolcraftensis (schoolcraftii)* LEA, Trans. Amer. Phil. Soc., Vol. V., p. 37, pl. iii., fig. 9, 1832.

*Unio prasinus* CONRAD, New Fresh-water Shells of the United States, p. 44, pl. iii., fig. 1, 1834.

*Unio dorfeuillianus* LEA, Trans. Amer. Phil. Soc., Vol. VI., p. 73, pl. xvii., fig. 54, 1836.

*Unio mortoni* CONRAD, Monograph of Unio, p. 11, pl. vi., fig. 1, 1836.

*Unio bullatus* RAFINESQUE, Conrad, Monograph of Unio, pl. xl., fig. 2, 1838.

*Unio pernodosus* LEA, Trans. Amer. Phil. Soc., Vol. X., p. 71, pl. iii., fig. 8, 1845.

*Unio asperatus* LEA, Journ. Phil. Acad., 2d series, Vol. V., p. 68, pl. vii., fig. 218, 1861.

*Shell*: Orbicular, sometimes inclining to quadrate, inflated, thick, heavy; dorsal border slightly curved, ventral border curved; rounded before, broadly rounded or truncated behind; surface roughened by lines of growth and marked with pustules, which may be very few or very numerous, and may fill the entire valve or only a small portion of it; the pustules vary in size and are either small or rounded knobs or long and narrow ridges; anterior umbonal slope rounded, posterior slope flattened or rounded, sometimes excavated; umbones varying from elevated to depressed, inflated, light greenish or brownish, marked by about four elevated ridges and numerous fine growth lines; the umbones are almost always eroded; ligament short, wide, stout, very dark horn, sometimes striped with a still darker color; epidermis varying from a uniform yellowish brown to yellowish with a broad band of dark green extending from the umbones to the ventral border, widening as it nears the latter region; in some specimens the green color is disposed on different parts of the shell in small patches; cardinal teeth double in both valves, equal in the left, the posterior the larger in the right valve, solid, triangular, deeply grooved, diverging; the cardinals are very variable, being wide or narrow, elevated or depressed, single or double, sulcated or almost smooth, and furnished with a number of accessory toothlets; lateral teeth short, stout, lamellar, elevated, serrated, directed ventrally; connecting bridge wide, thick, smooth or sulcated; anterior adductor muscle scar elliptical, very deeply excavated, strongly striated; posterior adductor muscle scar rounded, impressed, confluent, iridescent; *protractor pedis* scar as usual; dorsal muscle scars situated on the posterior face of the cardinal teeth, numerous, arranged in a straight line, deeply pitted; pallial line impressed, imbricated; cavity of the beaks deep; nacre pearly white, iridescent on the posterior region.

Length, 59.50; height, 58.00; breadth, 36.25 mill. (7763).

" 54.50; " 54.50; " 32.00 " (7763).

" 52.00; " 39.00; " 32.00 " ♀ (13444).

*Animal*: Generally flesh colored, lighter and darker in places; ctenidia short and wide, half-moon shaped, rounded at both ends, chocolate brown in color, united above and to the opposite pair for their entire length; the inner ctenidium is much the larger, and both are thickened posteriorly; labial palpi short, wide, ovate, adherent at base, in color like the ctenidia; foot whitish, tinged with yellowish or salmon; anal opening small,

without papillæ; branchial large with small blackish papillæ; mantle yellowish brown, approaching to salmon, edged with black; liver and cardiac pouch brownish; heart with very regular pulsations, numbering twenty-three per minute. Four gills used as marsupia.

*Distribution:* Ohio and North Carolina west to Kansas and Iowa, Wisconsin south to Louisiana and Texas.

*Geological distribution:* Pleistocene.

*Habitat:* Found in the larger rivers and lakes, on a muddy bottom.

*Remarks:* This is one of the most variable of North American Unios, and has received a large number of names, as the synonymy on the previous page shows. The shell varies from entirely smooth or with few pustules (*schoolcraftii*) to a condition where the whole valve is covered with pustules, and the pustules may be long and narrow or round. The umbones vary from depressed to elevated and the cardinal teeth show a dozen or fifteen different modifications. The writer has before him at the present time nineteen different varieties of this shell, from a number of States. It is a common and widely diffused species, and with all its mutation, is easily recognized when once known. It is quite common in the southern region, in Calumet Lake and River, and is also found in the Desplaines River, near Joliet.

\* \* \*

Ovisacs distinct, occupying a part of outer branchiæ of females. (Simpson.)

GENUS **OBLIQUARIA** (Rafinesque) Simpson, 1898.

*Shell:* Solid, inflated, oval in outline, obliquely truncated and pointed behind with a well developed posterior ridge; beaks prominent, sculptured with a few strong ridges which are heaviest where they cross the posterior ridge; posterior slope and sometimes the entire shell covered with wavy or chevron shaped folds; a row of three or four strong elevated nodules, compressed lengthwise, extends from the beaks down the center of the shell and the region behind this is somewhat excavated; epidermis bright and smooth, sometimes a little wrinkled, a uniform yellowish brown or painted with delicate broken green lines which often become zigzagged; left valve with two heavy pseudo-cardinals and two laterals, right valve with one strong pseudo-cardinal, with often a smaller one in front and behind it,

and a single lateral sometimes with a supplementary one below; cavity of the beaks rather shallow; anterior part of the shell very solid, posterior part much thinner.

*Animal:* Anal opening with only slight crenulations, branchial opening having numerous papillæ; mantle very thin with a broad, thick margin; branchiæ small, round below, inner much the larger, free nearly its whole length from the abdominal sac; marsupium consisting of from six to ten distinct ovisacs about the center of the outer gill or just behind it, which, when gravid, project far below the rest of it. (Simpson.)

**23. *Obliquaria reflexa*** Rafinesque, pl. xiv., fig. 5; pl. xx., fig. 2.

*Unio reflexus* RAFINESQUE, Mon. des Coq. Biv. it Fluv. Ohio, p. 306, 1820.

*Unio cornutus* BARNES, Amer. Jour. Sci. and Arts, 1st series, Vol. VI., p. 122, figs. 5a, 5b, 1823.

*Shell:* Roundly ovate, thick, heavy, inflated, broadly rounded before, triangular behind; dorsal border rounded, ventral border with a profound bulge; surface smooth, the lines of growth being very fine, ornamented by four large nodules which are placed in the center of the surface on a line drawn from the umbones to the central bulge; on the umbones the nodules are rounded, but as they near the ventral border they become very long and narrow; umbones elevated, inflated, ornamented with four large nodules and numerous fine, concentric growth lines, color light brown; anterior umbonal slope very broad and rounded; posterior slope excavated, with a strong shoulder extending from the umbones to the ventral border, making the shell strongly angular; ligament short, very wide, strong, dark brown; epidermis light grass green, yellowish green or brownish; some specimens are marked by numerous wide green or black rays, which are made up of more or less interrupted lines or zigzag shaped marks; cardinal teeth double in both valves, equal in the left valve and the posterior tooth much the smaller in the right valve, massive, heavy, broadly triangular, diverging, very heavily grooved; lateral teeth short, thick, serrated, directed ventrally; connecting bridge very thick, broad, flat, smooth; anterior adductor muscle scar longer than wide, very deeply excavated, strongly striated; posterior adductor muscle scar rounded, impressed, striated, confluent, iridescent; *protractor pedis* muscle scar wider than long, deeply excavated, striated; dorsal muscle scars numerous, situated on the posterior face of the cardinal teeth, small, deeply pitted; pallial line

impressed, crenulated; cavity of the beaks shallow; nacre silvery white, iridescent on the posterior part. The anterior part of the shell is much thicker than the posterior part.

Length, 49.50; height, 44.50; breadth, 29.50 mill. (1756).

" 47.00; " 46.00; " 30.00 " (1756).

*Animal*: Anal opening very small, apparently having small crenulations; branchial opening small with small thick set papillæ; branchiæ small, round below, inner the larger, free nearly the whole length of the abdominal sac; marsupium consisting of from four to six elongated ovisacs just behind the center of the outer gill. (Simpson.)

*Distribution*: Western New York west to Arkansas, Michigan south to Texas.

*Geological distribution*: Pleistocene.

*Habitat*: Found in rivers, in a few feet of water on a muddy bottom.

*Remarks*: *Reflexa* is a very distinct species, not to be confounded with any other form. It varies very much in its ornamentation from plain to strongly rayed, but the nodules seem to be very constant. It is a rare and very restricted species, at present only known from the Calumet River. The specimens from this locality are yellowish with fine black rays made up of small dashes of color placed longitudinally.

GENUS **PLAGIOLA** (Rafinesque) Agassiz, 1852.

*Shell*: Rather solid, somewhat triangular in outline, pointed posteriorly and having a sharply defined posterior ridge covered generally with a smooth epidermis which is often beautifully painted with wavy or zigzagged lines and markings; beaks not prominent, the region often being compressed; beak sculpture very faint, consisting of a few irregular corrugations; hinge line curved with two cardinals (pseudo-cardinals) and two laterals (pseudo-laterals) in the left valve, and one prominent cardinal (pseudo-cardinal) with sometimes one or two smaller ones, and one prominent lateral (pseudo-lateral), and a smaller inner one in the right valve. The female shell is generally slightly more inflated and developed in the postbasal region than that of the male, but in some cases it is extremely difficult to separate the sexes by the shell characters.

*Animal*: Branchial and anal openings provided with papillæ; posterior part of the outer gill of female used as a



marsupium, having distinct ovisacs much like *Lampsilis*; inner gill partly free from abdominal sac; mantle often fringed in front of branchial opening. (Simpson.)

GROUP OF *PLAGIOLA* *DONACIFORMIS*.

**24. *Plagiola donaciformis*** Lea, pl. xiii., fig. 4.

*Unio donaciformis* LEA, Trans. Amer. Phil. Soc., Vol. III., p. 266, pl. iv., fig. 3, 1827. Male.

*Unio zigzag* LEA, Trans. Amer. Phil. Soc., Vol. III., p. 409, pl. xii., fig. 19, 1829. Female.

*Shell*: Elliptically elongated, thick and solid, inflated; dorsal margin almost straight; ventral margin rounded; rounded before, acutely biangular in the male and somewhat truncated in the female; surface smooth and shining, lines of growth indicated by obtuse ridges; umbones not much elevated but much inflated, yellowish or greenish in color, marked by very many fine elevated ridges; anterior umbonal slope rounded; posterior slope long, slightly excavated, shorter in the female than in the male, and forming a rounded ridge or shoulder; ligament short, rather wide, dark horn color; epidermis light green or yellowish green, with numerous rays composed of V-shaped dashes; in the female the dashes are frequently larger and form somewhat continuous rays; cardinal teeth double in the left and single in the right valve, small, elevated, narrow, more or less triangular, coarsely serrated; the single tooth in the right valve is acutely triangular; lateral teeth long, directed ventrally, lamelliform, almost straight, rather thick, striated; the right lateral has a small depression near the posterior end; bridge between the teeth arched, narrow, thick; anterior adductor muscle scar longer than wide, deeply excavated, striated; posterior adductor muscle scar ovate, scarcely visible, confluent; *protractor pedis* muscle scar wider than long, deeply impressed, striated; dorsal muscle scar situated in the cavity of the beaks, numerous, deeply excavated; pallial line slightly impressed; cavity of the beaks rather deep in most specimens; nacre silvery white, iridescent, especially on the posterior part.

Length, 48.00; height, 32.50; breadth, 23.00 mill. ♂ (8366).

*Animal*: Marsupium occupying posterior half of outer gill of female in numerous distinct ovisacs; branchiæ small, inner much the larger, nearly semicircular; free from abdominal sac only at posterior end; mantle with many brown papillæ on postbasal edge; branchial and anal openings small, each with

many small brown papillæ; superanal opening rather large papillose. (Simpson.)

*Distribution:* Mississippi Valley, Michigan to Louisiana.

*Geological distribution:* Pleistocene.

*Habitat:* In rivers, on a muddy bottom.

*Remarks:* *Donaciformis* is easily distinguished by its zigzag epidermis. The males and females differ somewhat and have been described as distinct species. In the female the anterior end is rounded, projects beyond the umbones, which are elevated; the posterior end is short, truncated or obtusely biangular and considerably inflated. In the male the anterior end is short, while the posterior end is long and pointed, and somewhat compressed. It does not seem to be a common species, and but few specimens have been collected in the present area, where it is confined to the southern region.

**25. *Plagiola elegans*** Lea, pl. xxi., fig 1.

*Unio elegans* LEA, Trans. Amer. Phil. Soc., Vol. IV., p. 83, pl. ix., fig. 13, 1830-1.

*Unio truncatus* RAFINESQUE, Say in American Conchology, p. 67.

*Shell:* Trigonal, somewhat inflated, thick and solid, rounded before and obtusely biangulate behind; dorsal and ventral margins curved; surface smooth and shining, growth lines not prominent; umbones elevated, more or less inflated, yellowish or greenish in color, marked by several undulating, elevated ridges, generally eroded; anterior umbonal slope rounded, heart shaped when the valves are closed; posterior slope flat or excavated, separated from the sides of the shell by a strong ridge or shoulder; ligament short, wide, stout, dark brown or chestnut color; epidermis light yellowish green, with numerous dark green, zigzag rays, which are finer and smaller than in *donaciformis* (sometimes the rays are plain); cardinal teeth double in both valves, those in the left valve nearly equal, elevated, pyramidal or triangular, stout, serrated; those in the right valve unequal, the anterior being but a thickening of the hinge line, the posterior elevated, pyramidal, thick, striated; lateral teeth short, thin, lamelliform, serrated, curved ventrally; that in the right valve has a depression as in *donaciformis*; anterior adductor muscle scar squarish, deeply excavated, striated; posterior adductor muscle scar ovate, lightly impressed, confluent; *protractor pedis* muscle scar small, wider than long, deeply impressed and striated; dorsal muscle scars as in *donaciformis*; pallial line impressed; cavity of the beaks of good depth; nacre

silvery white, sometimes tinged with light lavender, iridescent, especially on the posterior part.

Length, 36.00; height, 31.00; breadth, 17.00 mill. ( 1768).

" 33.50; " 24.00; " 18.00 " ( 1768).

" 52.00; " 39.00; " 24.00 " (13440).

*Animal*: Anal opening small, with dark papillæ; branchial opening with a few black papillæ; mantle thin, with a wide, thickened border which is double and *slightly* toothed below; inner gill the larger in front, united throughout to the abdominal sac; outer gill larger behind; marsupia occupying the posterior part of the outer gill in about fifty ovisacs with a longitudinal fold far above its base. (Simpson.)

*Distribution*: Mississippi and Ohio Valleys and Lake Michigan.

*Geological distribution*: Pleistocene.

*Habitat*: Similar to *donaciformis*.

*Remarks*: This is a species which is frequently confounded with *P. donaciformis*. It has a much more trigonal shell and the zigzag character of the rays differs from *donaciformis*. In the latter species the zigzags are large and coarse and the V-s long, and scattered over the surface in connected festoons; in *elegans* the zigzags are small, the V-s short and placed in a regular disconnected series of rays. When once known the two species need never be confused. In some rare specimens the rays are not composed of zigzag rays, but are straight and thread like. It is not a common species, and is restricted to the southern region.

#### GENUS **LAMPSILIS** Rafinesque, 1820.

*Shell*: Oval to elongate, inflated, moderately solid, without a clearly defined posterior ridge, and never becoming arcuate with age, with a hard, bright, usually rayed epidermis; beak sculpture consisting for the most part of delicate parallel ridges which show a tendency to fall into an anterior and posterior loop. In the female the postbasal part of the shell is swollen opposite the part of the branchiæ which contains the embryos. Hinge containing two cardinals (pseudo-cardinals) and two laterals (pseudo-laterals) in the left valve, and one cardinal with sometimes a small second one above, and one lateral in the right valve.

*Animal*. Branchial opening papillose, anal opening generally having well developed papillæ; inner gills usually united

to the abdominal sac throughout their length; posterior part of the outer branchiæ becoming developed into a marsupium, consisting of distinct ovisacs whose lower ends are rounded; marsupium rounded on its base and projecting below the inner gill. (Simpson.)

### SECTION LAMPSILIS (typical).

#### GROUP OF LAMPSILIS VENTRICOSUS.

#### 26. *Lampsilis ventricosus* BARNES, pl. xii., figs. 3, 4, 5.

*Unio ventricosus* BARNES, Amer. Jour. Sci. & Arts, 1st series, Vol. VI., p. 267, figs. 14a, 14b, 14c, 1823.

*Unio accidens* LEA, Trans. Amer. Phil. Soc., Vol. III., p. 435, pl. x., fig. 16, 1829.

*Unio cardium* RAFINESQUE, Conrad, Monograph of Unio, p. 7, 1834.

*Unio satur* LEA, Trans. Amer. Phil. Soc., 2d series, Vol. X., p. 265, pl. xvii., fig. 19, 1852.

*Unio canadensis* LEA, Jour. Phil. Acad., Vol. IV., p. 268, pl. xlv., fig. 148, 1859.

*Unio subovatus* LEA, Reeve, Conch. Icon., Vol., XVI., *Unio*, pl. lxxxv., fig. 456 (not the true *subovatus*).

*Shell*: Large, inflated, subovate or elongately ovate, thick and heavy, rounded before and broadly rounded behind, the male being obtusely biangulate; dorsal margin slightly curved; ventral margin curved; surface smooth and polished, growth lines prominent; the height of the shell posterior to the umbones is very much greater than immediately in front of them; umbones prominent, inflated, yellowish brown in color, marked by six coarse, elevated ridges; anterior umbonal slope short, rounded; posterior slope long, flat, forming a decided angle; ligament rather short, wide, stout, dark chestnut; epidermis yellowish or yellowish green, with a few rather wide (sometimes narrow) rays extending from the umbones to the ventral border (the posterior portion is almost without rays in some specimens); cardinal teeth double in the left valve and single in the right, longer than wide, elevated, striated; the hinge line near the cardinal in the right valve is slightly enlarged, and may represent a second cardinal; lateral teeth strong, heavy, elevated, lamellar, crenelated, slightly curved; connecting bridge arched, narrow, smooth; anterior adductor muscle scar longer than wide, deeply excavated, especially near the cardinal teeth, striated; posterior adductor muscle scar rounded, as wide as long, concentrically striated, not much impressed; *protractor pedis* muscle scar wider than long, deeply impressed, coarsely striated; dorsal muscle scars situated on the posterior face of the cardinal teeth and the

under surface of the connecting plate, large, deeply excavated; pallial line deeply impressed anteriorly; cavity of the beaks deep; nacre silvery white, only slightly iridescent.

Length,	117.50;	height,	70.00;	breadth,	51.50 mill.	♂	(9319).
"	97.00;	"	65.00;	"	41.50	"	♀ (8054).
"	112.00;	"	73.00;	"	48.50	"	♀ (12425).
"	153.00;	"	93.00;	"	62.00	"	♂ (coll. Jensen).
"	107.00;	"	72.00;	"	56.00	"	♀ " "

*Animal:* Generally pearly white or flesh colored; anal and branchial openings of moderate size, both papillose; ctenidia long and wide, rounded before, pointed behind, strongly laminated, united above and to the opposite pair throughout their entire length; labial palpi long, wide, tongue shaped, united at base, light pearly or flesh colored; foot large and muscular, flesh colored; abdomen pearly and iridescent; mantle pearly white, edged with brown; siphons yellowish white inside, edged with blackish brown; in all of the specimens examined by the writer the posterior part of the abdomen was supplied with a small triangular appendage of unknown function; liver dark brown; heart pulsations regular, seventeen to eighteen per minute. The posterior half of the outer branchium is used as a marsupium.

*Distribution:* New York west to Iowa, southern Canada south to Louisiana.

*Geological distribution:* Pleistocene.

*Habitat:* In lakes and rivers of some size, generally on a muddy bottom.

*Remarks:* A very distinct species, like no other in the region, the peculiar slope of the posterior portion of the shell at once distinguishing it. The female is more produced posteriorly than the male, the latter having the posterior end much sharper, and also having a peculiar bulge in the ventral part of the shell, just posterior to the center. The rays vary from very narrow threads to wide bands and are placed differently from any other species. It seems to be rather widely distributed in the area, and is fairly common. A specimen from the Little Calumet River, collected by Mr. Jensen, weighed one pound and one and a half ounces when alive.

**27. *Lampsilis multiradiatus* Lea, pl. xxi, figs. 2, 3.**

*Unio multiradiatus* LEA, Trans. Amer. Phil. Soc., Vol. III., p. 409, pl. ix., fig. 15, 1829.

*Shell:* Subovate, of medium size, rather solid, inflated,

rounded before and broadly elliptical behind, the female broader than the male; dorsal and ventral margins curved; surface smooth and shining; growth lines prominent near the ventral border; umbones not elevated, inflated, dark reddish brown in color, and marked by five elevated, undulating ridges, causing the umbo to resemble a miniature *Quadrula plicata*; anterior umbonal slope rounded, posterior slope broadly rounded; ligament short, wide, stout, dark chestnut color; epidermis yellowish green, tinged with dark red, and marked by very many dark green rays, which are wavy in outline and vary greatly in width; cardinal teeth double in both valves, nearly equal in the left, and the anterior tooth very small in the right, elevated, triangular, serrated on the edge, all pointed forward; the anterior tooth in the right valve is indicated only by a thickening of the margin; lateral teeth short, thin, lamelliform, more elevated in the center than at each end, striated; anterior adductor muscle scar much longer than wide, very deeply impressed, coarsely striated; posterior adductor muscle scar rounded, as wide as long, not deeply impressed, concentrically striated, confluent; *protractor pedis* muscle scar wider than long, deeply impressed, striated, longer at the anterior than at the posterior end; dorsal muscle scars situated in the cavity of the beaks and on the posterior face of the cardinal teeth, numerous, deeply pitted; cavity of the beaks rather deep; pallial line very wide, impressed; nacre silvery white, iridescent, especially on the posterior part, showing the rays through the shell on the ventral and posterior borders; the center of the shell has what the silversmiths would call a "satin finish."

Length, 52.00; height, 37.00; breadth, 23.00 mill. ♂ (7502).

" 60.00; " 45.00; " 30.00 " ♀ (7503).

" 43.00; " 32.00; " 20.00 " ♀ (7501).

*Animal*: Anal opening rather large, with dark papillæ; branchial opening large, with coarse, dark papillæ; mantle border greatly thickened and dentate below; inner gill much the larger in front, united to the abdominal sac throughout; marsupium occupying the posterior half of the outer gill of the female, ovisacs large, dark below. (Simpson.)

*Distribution*: Mississippi and Ohio valleys and Lake Michigan.

*Geological distribution*: Pleistocene.

*Habitat*: Same as *L. iris*.

*Remarks:* A species at once distinguished by its subovate outline, inflated beaks and numerous rays, which radiate from the umbones to the ventral and lateral margins. The umbonal markings are very distinct and peculiar, and the wavy character of the rays is not found in any other species which inhabit this area. It seems to be confined to the lakes in the southern region.

SECTION METAPTERA Rafinesque.

GROUP OF LAMPSILIS ALATUS.

**28. *Lampsilis alatus* Say, pl. xviii.**

*Unio alatus* SAY, Nich. Encyc. Vol. IV., fig. 2, 1816.

*Shell:* Large, rather solid, symphynote, broadly oval in outline in old specimens but obtusely triangular in strongly alate forms, somewhat inflated when adult but compressed when young, rounded before and generally very broadly rounded behind, although some specimens are triangulate; umbonal slopes rounded; the alate postero-dorsal margin is very much compressed, and when perfect is exactly triangular in shape, extending from the umbones to the posterior end of the shell; in old specimens, or those in which the "wing" is not fully developed, the shape is not so clearly defined; ventral margin slightly rounded; surface smooth and shining on the central part of the shell, with the lines of growth large and coarse on the anterior, posterior and ventral margins and the alate portions; epidermis black or greenish black, in the young yellowish horn, perfectly plain and rayless in old specimens but distinctly rayed with numerous fine green rays over a yellowish background in young and half grown specimens; umbones depressed, flush with the hinge line, ornamented by several very fine raised ridges; ligament large, solid, light brown in color; cardinal teeth double in both valves, those in the left valve about equal in size, long and narrow, elevated, strongly grooved on their anterior faces; those in the right valve unequal in size, the anterior tooth small, the posterior tooth large and similar in form to those of the left valve; lateral teeth long, thin, lamellar, elevated, very slightly arcuate, smooth; anterior adductor muscle scar deeply impressed, striated; posterior adductor muscle scar large, very indistinct, confluent; *protractor pedis* muscle scar deeply impressed, striated; pallial line distinct, impressed, somewhat crenulated; dorsal muscle scars in the cavity of the beaks and arranged in nearly a straight row, deeply pitted; there are from six to seven

small, rounded pits, followed by a single long and narrow scar very deeply impressed; cavity of the beak wide, shallow; nacre varying from deep purple, through mauve to salmon pink, iridescent.

Length, 114.00; height, 74.00; breadth, 36.00 mill.

" 121.00; " 92.00; " 37.00 "

" 68.00; " 59.00; " 19.00 "

*Animal:* Anal opening small, without papillæ; branchial opening small with vestiges of papillæ; palpi subtriangular, united only slightly behind; inner gill united throughout to abdominal sac; branchial uterus occupying posterior part of the outer gill, very distinct, projecting below inner gill. (Simpson).

*Distribution:* Western New York west to Nebraska and Iowa, Wisconsin south to New Mexico.

*Geological distribution:* Pleistocene.

*Habitat:* In the larger lakes and rivers, on a muddy bottom, in water from five to twenty feet in depth.

*Remarks:* *Alatus* is a very distinct species, easily known by its rich purple interior and very alate postero-dorsal margin. The latter is more pronounced in young than in old specimens, the latter becoming more oval in form and losing to some degree their pronounced alate character. The division between the posterior umbonal slope and the alate "wing" is marked by an area of the lines of growth which is raised in strong, wavy ridges. The rays vary to some extent, the young shell having rather wide green rays on a yellowish background; half-grown specimens have narrow rays on a yellowish green background, while old specimens have a perfectly rayless epidermis. The cardinal teeth also vary in some specimens, being rather long and narrow, with sulcations on the anterior faces, while in others they are more solid, wider, long, triangular, and the sulcations are extended to the upper surface of the teeth, which are all directed toward the antero-ventral border of the shell. The anterior adductor muscle scar almost always has a heavy ridge between it and the *protractor pedis* scar, the ridge bearing a portion of the adductor scar. The alate portion of the shell extends far above the lateral teeth. This species has been found in the southern region in the Calumet River, and in the western region in the Desplaines River. It does not appear to be common.



**29. *Lampsilis gracilis* Barnes, pl. xix., fig. 1.**

*Unio gracilis* BARNES, Amer. Journ. of Sci. and Arts, 1st series, Vol. VI., p. 274, 1823.

*Unio fragilis* RAF., Conrad, Mon., pl. xxx., 1836.

*Unio dolosus* LEA, Journ. Phil. Acad., Vol. V., p. 75, pl. ix., fig. 224, 1861.

*Shell*: Elliptical, compressed, alate, rather thin; rounded before and very broadly rounded behind (sometimes obtusely triangular); dorsal margin straight, ventral margin rounded; dorsal margin alate posteriorly and the shell produced postero-ventrally; surface generally smooth and shining, the growth lines very faint, excepting on the alate portion; in old specimens the growth lines are more prominent; umbones very much depressed, light or dark horn color, marked by four wrinkles arranged in a double loop; in older specimens the umbones become almost smooth or are eroded; anterior umbonal slope almost flat, posterior slope long, subexcavated; ligament weak, long and narrow, very dark horn color; epidermis yellowish, with numerous grass green rays extending diagonally from the umbones to the base and posterior end; some specimens are plain yellow or yellowish horn; cardinal teeth weak, very thin, elevated, striated on the inner face, single in each valve, that in the right valve much the larger, lateral, teeth more solid than cardinals, long, lamellar, elevated, minutely striated, very slightly curved; no connecting plate between cardinal and lateral teeth; anterior adductor muscle scar longer than wide, impressed, striated; posterior adductor muscle scar very wide, not much impressed, confluent; *protractor pedis* muscle scar wider than long, impressed, striated; dorsal muscle scars arranged in almost a straight line under the cavity of the beaks, six to eleven in number in each valve, rather heavily impressed; cavity of the beaks very shallow; pallial line more or less distinct; nacre silvery white, salmon tinged in the center of the shell, more or less iridescent.

Length, 124.00; height, 78.00; breadth, 41.00 mill. (coll. Jensen).

" 88.00; " 61.00; " 26.00 " (12945).

*Animal*: Edges of anal opening very much thickened, without papillæ; branchial opening small, with large, irregular papillæ; mantle greatly thickened on its lower edge; palpi long, elliptical, united over halfway behind; inner gill much the larger, rounded below, united the whole length of the abdominal sac; marsupium enormous, with forty ovisacs, occupying the posterior three-fifths of the outer gill. (Simpson.)

*Distribution:* Ottawa River, Canada, to Minnesota, Iowa and Kansas, and south to Central Alabama and Texas. (Call.)

*Geological distribution:* Pleistocene.

*Habitat:* Found in rivers and sloughs where there is a muddy bottom and not much current.

*Remarks:* This is a distinct shell and is quite readily identified. Its peculiar yellow surface, with green rays (sometimes pure yellow, without rays), its depressed umbones and its alate postern-dorsal margin will at once distinguish it. It may be distinguished from *L. alatus* by its yellowish color, weak teeth and thinner shell. Very old specimens lose the alate character and become broadly elliptical in outline, and some specimens have the posterior end very much produced. The very weak hinge teeth allies this species to the members of the genus *Alasmodonta*, and under very favorable conditions it might become, by living in a quiet, muddy pond, an *Anodonta* by the atrophy of the teeth. In some individuals the cardinal teeth are so small that they appear as simple nodules. The position of the *protractor pedis* muscle scar is quite peculiar. The species does not appear to be very common, but is rather widely distributed. A specimen from Thorn Creek weighed one pound and one ounce when alive. (*Vide* Jensen.)

#### SECTION EURYMA Rafinesque, 1820.

##### GROUP OF LAMPSILIS ANODONTOIDES.

#### 30. *Lampsilis anodontoides* Lea, pl. x., figs. 1, 2, 3.

*Unio anodontoides* LEA, Trans. Amer. Phil. Soc., Vol. IV., pp. 81, 89, pl. viii., fig. 11, 1830.

*Unio teres* RAFINESQUE, *vide* Conrad's monograph, pl. xxviii.

*Unio floridensis* LEA, Trans. Amer. Phil. Soc., Vol. X, p. 274, pl. xxi., fig. 31, 1852.

*Shell:* Solid, very long, somewhat inflated, rounded before and acutely pointed behind, the female much swollen and produced in this region; dorsal and ventral margins about straight; surface smooth and shining, frequently highly polished; umbones placed anteriorly, prominent but not much elevated, marked by from five to seven scarcely elevated wrinkles arranged in a long double loop; ligament elevated, strong, wide, dark chestnut color; epidermis varying from plain yellow without rays to light green with dark green rays; in some specimens the posterior umbonal slope is painted with dark green; anterior umbonal slope rounded, short; posterior slope long, slightly excavated; cardinal teeth double in both valves, elevated, long

and narrow, compressed, serrated; lateral teeth very long, lamelliform, elevated, striated; connecting bridge between cardinals and laterals narrow, thin; anterior adductor muscle scar as wide as high, deeply impressed, striated, confluent; posterior adductor muscle scar wide, distinct, confluent; *protractor pedis* muscle scar long and narrow, deeply impressed; dorsal muscle scars numerous, deeply impressed, situated in the cavity of the beaks; pallial line impressed; cavity of the beaks shallow; nacre silvery white, pearly and iridescent.

Length, 79.00; height, 32.00; breadth, 26.00 mill. ♂ (12442).

" 78.00; " 35.00; " 27.00 " ♀ (12442).

*Animal*: Anal opening small, with many light brown papillæ; branchial opening small, papillose; palpi large, subtriangular, united half way posteriorly; branchiæ very long, curved below, inner the larger, united the whole of its length to the abdominal sac; posterior half of the outer gill of female used as a marsupium, composed of large ovisacs with rounded bases which are stained black. (Simpson.)

*Distribution*: New York to Kansas, Minnesota to Texas, Alabama and Florida.

*Geological distribution*: Pleistocene.

*Habitat*: Prefers a muddy bottom where it can bury itself. Found in rather deep water, generally.

*Remarks*: *Anodontoides* is frequently confounded with *luteolus*, but may be distinguished by the following characteristics: *Luteolus* is never so sharply pointed posteriorly, but is rounded; the shell of the present species is longer compared with its height than is *luteolus*; the female of the *luteolus* is much more swollen posteriorly than is that of *anodontoides*. The present species is not as widely distributed throughout the region under consideration as *luteolus*, and the individuals are not so numerous. The Desplaines River and its tributaries is the only stream, so far as known, in which this species is found. The epidermis varies from a perfectly plain yellow to yellowish green, rayed with dark green. Thus far it has only been found in the western region.

### 31. *Lampsilis rectus* Lamarck, pl. xvii., figs. 1, 2.

*Unio rectus* LAM., Hist. Nat. des Anim. sans Vert., Vol. VI., p. 74, 1819.

*Unio proelongus* BARNES, Amer. Jour. Sci. and Arts, 1st series, Vol. VI., p. 261, fig. 11, 1823.

*Unio sageri* CONRAD, Monograph of Unio, p. 53, pl. xxix., 1836.

*Unio leprosus* MILES, Ann. Rep. Geol. Surv. Michigan, p. 240, 1861.

*Shell*: Large, elongated, compressed, thick and heavy, rounded before, pointed triangular behind; dorsal margin nearly straight; ventral margin slightly rounded, much produced posteriorly in the female; surface smooth and shining, growth lines well marked, imbricated on the lower half of the shell and more or less on the anterior and posterior ends; umbones depressed, inflated, brownish, rather small, marked by numerous fine ridges; anterior umbonal slope rounded; posterior slope rounded near the posterior part of the shell, but more or less angular near the umbones; ligament long, wide, stout, very dark brown or black; epidermis corneous or blackish, with a reddish tinge, obscurely rayed with broad, dark green bands of color, which disappear in old specimens; cardinal teeth double in both valves, those in the left valve about equal in size, the anterior tooth in the right valve generally very small, but by an enlargement of the hinge line, sometimes quite large and elevated; teeth generally posteriorly recurved and erect, stout, triangular and heavily serrated, sometimes thin, sharp, very much elevated and serrated; lateral teeth long, straight, lamelliform, elevated, crenulated; anterior adductor muscle scar wing shaped, longer than wide, very deeply excavated, striated; posterior adductor muscle scar rounded, diameters equal, generally, distinct but hardly impressed, concentrically striated; *protractor pedis* muscle scar wider than long, very deeply impressed, striated; pallial line crenulated, deeply impressed anteriorly; dorsal muscle scars situated in the center of the cavity of the beaks, large, oval, forming deep pits; cavity of the beaks very shallow; nacre silvery white or dark purple, and exhibiting all variations between these two colors; some specimens are white about the ventral and anterior and posterior portions, and deep purple or pink in the region beneath the hinge teeth.

Length, 106.00; height, 45.00; breadth, 27.00 mill. ♂ (9718).

" 116.00; " 53.00; " 33.00 " ♂ (12440).

*Animal*: Anal opening small, without papillæ; branchial opening moderate, with many irregular papillæ; mantle edge thick and doubled; outer edge plain, inner with beautiful regular teeth on posterior half; inner gill the larger, united nearly the whole length to abdominal sac; branchial uterus occupying position two-fifths of outer branchiæ in thirty-two distinct ovisacs. (Simpson.)

*Distribution:* New York west to Nebraska, Michigan south to Texas and Georgia.

*Geological distribution:* Pleistocene.

*Habitat:* In lakes or rivers of considerable size, on a muddy bottom, in from five to twenty feet of water.

*Remarks:* A very distinct species, which can be confounded with no other; the females have the postero-ventral portion very much produced. It is one of the heaviest species we have. The nacre of the shell is the most beautiful of any of our species, varying from pure white to deep purple. It is confined to the southern and western regions.

#### GROUP OF LAMPSILIS LUTEOLUS.

#### 32. *Lampsilis luteolus* Lamarck, pl. xi.; pl. xxvii., fig. 12.

*Unio luteolus* LAM., Animaux sans Vertebres, Vol. VI., p. 79, 1818.

*Unio siliquioideus* BARNES, Amer. Jour. Sci. and Arts, 1st series, Vol. VI., p. 269, fig. 15, 1823.

*Unio inflatus* BARNES, Amer. Jour. Sci. and Arts, Vol. VI., p. 266, 1823.

*Unio approximatus* LEA, Trans. Amer. Phil. Soc., Vol. X. p. 74, pl. v., fig. 13, 1848.

*Unio affinis* LEA, Trans. Amer. Phil. Soc., Vol. X., p. 271, pl. xix., fig. 26, 1852.

*Unio distans* ANTHONY, Amer. Journ. of Conch., Vol. I., p. 156, 1865.

*Shell:* Large, elliptical, thin or very thick, more or less inflated, symmetrically rounded before and elongately oval behind, the female generally very obtuse; dorsal margin straight; ventral margin very slightly curved in the male and much produced in the female; surface smooth and polished in some specimens, roughened by growth lines in others; umbones prominent, inflated, but not much elevated, brownish or greenish in color, generally eroded, and marked by about fourteen fine, undulating, elevated ridges, the apex directed anteriorly; ligament short, rather wide, stout, dark chestnut color; epidermis varying from light, yellowish green to dark horn color or dark green, and generally with numerous dark green rays, which radiate from the umbones; the rays may be straight or crenulated and vary in width from 0.25 to 2.00 mill.; in old specimens the rays may be few in number, indistinct or wanting; anterior umbonal slope gracefully rounded, posterior long and flat, or slightly excavated; cardinal teeth double in both valves; left anterior cardinal elevated, tooth-like, striated, right posterior long and narrow, not so much elevated, striated; right anterior cardinal very small, posterior large, elevated, pyramidal, coarsely striated

and notched; laterals long and narrow, elevated, striated; anterior adductor muscle scar excavated, longer than wide, coarsely striated; posterior adductor muscle scar as long as wide, large, not very deeply impressed, more or less confluent; *protractor pedis* muscle scar wider than long, deeply impressed and marked by strong crenulations; dorsal muscle scars numerous, situated in the cavity of the beaks, the posterior scars the larger, all very deeply excavated; pallial line well marked; cavity of the beaks shallow; nacre white, more or less iridescent.

Length,	116 00;	height,	63.00;	breadth,	48.00	mill.	♀	(9295).
"	115.00;	"	56.00;	"	42.00	"	♀	(9294).
"	81.00;	"	43.00;	"	41.00	"	♂	(10360).
"	85 00;	"	47.00;	"	33 00	"	♀	(8053).
"	61.00;	"	39 00;	"	26.00	"	♂	(9631).

*Animal:* General color whitish or cream, tentacular portion of mantle brownish; anal opening small, without papillæ; branchial opening larger with numerous papillæ; labial palpi large, cream colored, triangular, almost as broad as long, united at base and for a short distance along the superior border; ctenidia large, the outer one the smaller, rounded, united above, color pearly white; foot large, white, plough shaped; liver brown; gills of the female darker than the male. The heart may be seen very plainly through the transparent walls of the pericardium; the pulsations are wavelike, regular and number sixteen per minute. The posterior part of the outer gill is used as a marsupium.

*Distribution:* British America, from Great Slave Lake south to Texas; New York west to Montana and Dakota.

*Geological distribution:* Pleistocene.

*Habitat:* Found plentifully in the larger lakes and rivers, on a muddy bottom. In the DuPage River the specimens are found in a black, sticky mud, in a few feet of water.

*Remarks:* This species is subject to very great variation, as the synonymy shows. In the sets before me, representing every portion of the area, there are specimens running from bright green, beautifully rayed, to dark brown with scarcely an indication of rays. They vary in shape from short oval to a long ellipse. In thickness the variation is also great, those individuals found in Lake Michigan being much more ponderous than those from the smaller lakes and rivers. This variation is due to the fact that Lake Michigan specimens are subject to rough handling by the waves while those inhabiting the smaller lakes and rivers are more or less protected from wave action. Speci-

mens from Wolf Lake are generally small, rather thin and delicately and beautifully rayed. Specimens from Lisle, DuPage River are more compressed and higher in relation to length than are the specimens, generally, from other regions. The present species is frequently confounded with *anodontoides*, but is quite distinct from that species.

Specimens collected July 25, 1896, contained embryos in the posterior third of the outer ctenidium measuring one-fifth of a mill. in diameter. The ctenidia at this time were much swollen and the embryos very numerous. The species in captivity is remarkably active, ploughing its way through the sandy or muddy bottom with considerable speed. The writer has noticed that the excurrent siphon continually opens and closes, and at each closing a current of water filled with foetid matter is ejected. This operation is repeated on an average of twelve times in a minute.

#### GROUP OF LAMPSILIS IRIS.

### 33. *Lampsilis iris* Lea, pl. xiii., fig. 1; pl. xiv., fig. 2.

*Unio iris* LEA, Trans. Amer. Phil. Soc., Vol. III., pp. 409, 411, 421, 439, pl. xi., fig. 18, 1829.

*Unio novi-eboraci* LEA, Trans. Amer. Phil. Soc., Vol. VI., pp. 127, 147, 1838. Journ. Phil. Acad., Vol. IV., p. 47, pl. v., fig. 14, 1858.

*Shell*: Rather small, stout, compressed, elliptical, rounded before, triangular behind in the male and broadly rounded in the female; dorsal margin nearly straight, ventral margin rounded; surface smooth and polished, marked by distinct lines of growth; umbones depressed, compressed, the apex directed anteriorly, dark reddish brown, marked by five elevated ridges which are more or less broken up into nodules; anterior umbonal slope short and rounded; posterior slope long, flat, forming an obtuse angle; ligament long, narrow, stout, dark horn colored; epidermis yellowish or yellowish green, with numerous wide, interrupted dark green rays extending from the umbones to the ventral margin; cardinal teeth double in both valves, about equal in the left; the anterior teeth in the right valve very small, all elevated, triangular, serrated and striated; lateral teeth long, thin, lamellar, striated, almost straight; anterior adductor muscle scar much longer than wide, deeply excavated, striated; posterior adductor muscle scar large, as wide as high, faintly marked, confluent; *protractor pedis* muscle scar wider than high, deeply impressed, striated; dorsal muscle scars situated in the cavity of the beaks, large, deeply excavated; pallial line

impressed; cavity of the beaks shallow; nacre pearly white, iridescent, especially on the posterior part.

Length, 57.00; height, 30.00; breadth, 20.00 mill. (7386).

" 55.50; " 30.00; " 20.00 " (7385).

" 43.00; " 23.00; " 15.00 " (7384).

*Animal:* Generally whitish, inclining to flesh color; anal opening rather small, not provided with papillæ; branchial large, papillose; mantle yellowish or flesh colored, edged with brown; ctenidia short and wide, elongately rounded behind and obtusely rounded before, the inner gill the larger, united above throughout their entire length; foot long and tongue shaped, muscular; labial palpi tongue shaped, small, yellowish, united at base; abdomen yellowish; siphons brownish; heart pulsations fourteen, regular. The posterior part of the outer branchium is modified to form a marsupium.

*Distribution:* New York west to Illinois, Michigan south to Louisiana and Texas.

*Geological distribution:* Pleistocene.

*Habitat:* Found in lakes and rivers, in a few feet of water, on a sandy or muddy bottom.

*Remarks:* A distinct little species, distinguished by the interrupted rays, which appear to be concentric lines of square dots in some specimens. In a few specimens examined the rays were not broken, but were entire and gradually increasing in width as they neared the ventral border. This is one of the most common species found in this area, and also one of the most beautiful. It is widely distributed.

**34. *Lampsilis spatulatus*** Lea, pl. x., fig. 5; pl. xiii., fig. 2.

*Unio spatulatus* LEA, Trans. Amer. Phil. Soc., Vol. X., p. 80, pl. viii., fig. 22, 1845.

*Shell:* Elliptical, compressed, thick and heavy, rounded before, triangular behind; dorsal and ventral borders curved; surface roughened by the lines of growth which form scales on the ventral border; umbones depressed, inflated, light brown in color, marked by seven or eight delicate, wavy ridges; anterior umbonal slope rounded; posterior slope long and almost flat, slightly angled; ligament short, wide, stout, very dark chestnut; epidermis dark yellowish brown, or greenish yellow, marked with rather wide, uninterrupted dark green rays, which are more distinct on the center of the shell than elsewhere; cardinal



teeth double in both valves, equal in the left and the anterior tooth very small in the right, thick, solid, triangular, deeply serrated; lateral teeth rather short, thick, solid, not much elevated, almost smooth, the lateral in the right valve very wide at the base and rapidly coming to a point; connecting plate very thin and narrow; anterior adductor muscle scar very deeply excavated, longer than wide, coarsely striated; posterior adductor muscle scar rounded, length and breadth equal, deeply impressed, striated; *protractor pedis* muscle scar wider than long, deeply excavated, striated; dorsal muscle scars situated on the posterior face of the cardinal teeth and on the wall of the cavity of the beaks, numerous, very deeply pitted; pallial line deeply impressed, especially on the anterior end; cavity of the beaks very shallow; nacre silvery white, iridescent, particularly on the posterior portion of the shell.

Length, 82.00; height, 46.00; breadth, 28.50 mill. (9840).

" 61.00; " 39.00; " 22.00 " (9840).

" 65.50; " 35.00; " 20.00 " (12419).

*Animal:* Generally flesh colored; anal opening small, without papillæ branchial opening rather large, papillose; ctenidia not large, wide, rounded before, pointed behind, yellowish brown in color, united above for their whole length; labial palpi not large, rounded, triangular, yellowish white, united at base; siphons yellowish white inside, edged with a wide line of brownish black; mantle whitish or brownish, edged with black; liver dark brown; foot yellowish brown or dark flesh color; abdomen pearly white, flecked with pure white near the dorsal border. The posterior part of the outer branchium is used as a marsupium. Heart regular, sixteen beats per minute.

*Distribution:* Mississippi Valley.

*Geological distribution:* Pleistocene.

*Habitat:* Ponds and rivers, buried in black, slimy mud to a depth of four or five inches.

*Remarks:* *Spatulatus* is not a common species and has only been found in the DuPage River and Hickory Creek. It is frequently confounded with *iris*, but that species is almost always marked by interrupted rays while in *spatulatus* the rays are plain and uninterrupted; it is also larger and heavier than *iris*, and the posterior end is more pointed. It seems to be confined to the Desplaines River drainage.

## GROUP OF LAMPSILIS LIGAMENTINUS.

**35. *Lampsilis ligamentinus*** Lamarck, pl. xvi.

*Unio ligamentina* LAM., Animaux sans Vertebres, Vol. VI., p. 72, 1819.

*Unio ligamentinus* LAM., Animaux sans Vertebres, Vol. VI., p. 533, 1838.

*Unio crassus* SAY, Nich. Encyc., Amer. Ed., Art. Conch., pl. i., fig. 8, 1816.

*Unio carinatus* BARNES, Amer. Journ. Sci. and Arts, 1st series, Vol. VI., pp. 126-259, pl. ii., fig 10, 1823.

*Unio ellipticus* BARNES, Amer. Journ. Sci. and Arts, 1st series, Vol. VI., pl. xiii., fig. 19, 1823.

*Unio fasciatus* RAFINESQUE, Conrad, Monograph of Unio, p. 3, pl. i., 1836.

*Unio upsoni* MARSH, Mss. vide CALL, Trans. Acad. Sci., St. Louis, Vol. VII., p. 23, 1895.

*Shell*: Large, compressed, thick and heavy, elliptical, rounded before and biangulate behind; dorsal and ventral margins rounded; surface smooth and shining in the young and with raised line of growth in old specimens; the shell is much thicker anteriorly than posteriorly; umbones not prominent, a little swollen, brownish in color, and marked by seven or eight fine, undulating, concentric folds; in old specimens the umbones are eroded; anterior umbonal slope rounded, posterior slope forming an angle; ligament rather long, thick, very dark chestnut color; epidermis yellowish or light greenish with numerous dark green rays extending from the umbones to the ventral border; old specimens are very dark; the rays vary in width from very narrow to broad stripes; cardinal teeth double in both valves, those in the left valve about equal, triangular, crenulated; the anterior cardinal in the right valve very small, the posterior large, triangular, crenulated; lateral teeth strong, heavy, elevated, lamellar, crenulated, curved toward the ventral margin; connecting plate smooth, arched, rather thick; anterior adductor muscle scar deeply excavated, a trifle longer than wide, strongly striated; posterior adductor muscle scar as wide as long, lightly impressed, confluent; *protractor pedis* scar wider than long, deeply impressed, striated; dorsal muscle scars situated on the posterior face of the cardinal teeth and connecting bridge, numerous, large, deeply impressed; pallial line wide, impressed; cavity of the beaks of medium depth; nacre white, varying to bluish and pinkish, iridescent.

Length, 72.00; height, 41.50; breadth, 23.00 mill. (12442).

" 98 00; " 58.00; " 35.00 " (12423, Kankakee River).

*Animal*: Anal opening large with an irregular crenulated edge; branchial opening large with many small brown papillæ; palpi small, subelliptical, united one-third of the way posteriorly;

branchiæ very large, nearly circular below, inner larger, united to abdominal sac or free; marsupium occupying two-thirds of the posterior part of outer branchiæ, greatly distended. (Simpson.)

*Distribution:* New York to Dakota and Kansas, Michigan and Minnesota to Louisiana and Alabama.

*Geological distribution:* Pleistocene.

*Habitat:* Found in muddy and sluggish rivers, in soft mud.

*Remarks:* This is a variable species which is frequently confounded with *luteolus*. It is a more elliptical shell in general, but the ornamentation of the umbones shows the greatest difference; in *luteolus* they are of good size, numerous and wavy, while in *ligamentinus* they are small and few in number. The nacre is very variable, passing from pure white, through bluish white, to pinkish. The epidermis of the present species varies somewhat, some specimens being yellowish with wide dark green rays, while other specimens are almost black, the rays being represented only by darker bands. When at its best, it is one of our most beautiful shells. It seems to be confined to the Desplaines River drainage.

## SECTION CORUNCULINA Simpson.

### GROUP OF LAMPSILIS PARVUS.

#### 36. *Lampsilis parvus* Barnes, pl. xiii., fig. 3.

*Unio parvus* BARNES, Amer. Jour. Sci. and Arts, 1st series, Vol. VI., p. 274, fig. 18, 1823.

*Shell:* Small, thin, inflated, elliptical, rounded before and behind; dorsal border straight, ventral border very slightly rounded; surface roughened by coarse lines of growth which are more or less elevated; umbones large for the size of the shell, not elevated, inflated, yellowish brown in color, marked by five or six elevated, strong, parallel curved ridges, which are nearer the hinge line posteriorly than anteriorly; anterior umbonal slope rounded, posterior slope rounded or with a slight angle, excavated near the beaks; ligament long, narrow, fragile, dark horn color; epidermis blackish or olive green, sometimes with a golden luster, rayless; cardinal teeth small, single in the right and double in the left valve, erect, thin, acuminate, serrated, widely separated; there is sometimes a second very small tooth in the right valve, near the hinge line; lateral teeth long, slightly striate, smooth, lamellar; anterior adductor muscle scar forming a truncated oval, impressed; posterior adductor

muscle scar roundly ovate, scarcely impressed, confluent; *protractor pedis* muscle scar small, wider than long, deeply impressed; dorsal muscle scars minute, placed in the cavity of the beaks (which are large but not deep), deeply impressed; pallial line distinct, impressed anteriorly; nacre pearly or silvery white, iridescent, especially posteriorly.

Length, 21.00; height, 12.00; breadth, 8.50 mill. ♂ (10084).

" 21.00; " 12.50; " 9.00 " ♂ (10084).

" 30.00; " 14.00; " 12.00 " ♂ (12415).

*Animal:* Generally whitish or yellowish white in color; ctenidia not large, rounded at both ends, united above throughout their entire length, pearly white in color, with a line of yellowish at their junction; the posterior extremity is thicker than the anterior; labial palpi rather large, whitish flecked with yellowish, triangular, united at base and partly on the posterior margin; anal and branchial openings rather large, edged with dark brown; the female is provided with a caruncle supported by a pedicel; mantle edged with black; foot large, pointed; abdomen yellowish white; liver greenish brown; heart pulsations regular, thirty-six per minute; this is the largest number of pulsations for the genus. Posterior part of outer gill used as a marsupium.

*Distribution:* Minnesota south to Texas, Western New York west to Iowa.

*Geological distribution:* Pleistocene.

*Habitat:* Found buried in soft mud to a depth of from an inch to six or seven inches. It prefers slow moving streams, where there is a muddy bottom.

*Remarks:* This is the smallest *Unio* found in our region. The female is distinguished from the male by a pronounced swelling in the posterior portion. It is interesting to watch this tiny species moving about the bottom of an aquarium; it will lie for a long time on the bottom, its siphons extended to their full length, a current of water continually flowing from the excurrent siphon; if it desires to move, the long and finger like foot will be cautiously thrust out, extended its full length, and the shell pulled after it with a jerk. The umbonal sculpture is the coarsest of any *Unio* in this region, in proportion to the size of the shell. The young sometimes have one or two broad green bands, but the adult is completely rayless. The species is confined to the Desplaines River drainage.

**ORDER TELEODESMACEA.**

"Pelecypods with reticulate gills, the ventricle of the heart embracing the rectum; having the lobes of the mantle generally more or less connected and usually possessing developed siphons; the adductors practically equal; the shell structure cellulo-crystalline (porcellanous) or obscurely prismatic, never nacreous; the dorsal area, if present, always prosodetic or divided into lunule and escutcheon; ligament opisthodetic, with or without separate resilium; without a lithodesma, rarely with external accessory shelly pieces; armature of the hinge characterized by the separation of the hinge teeth into distinct cardinals and laterals, the posterior laterals when present are behind the ligament; the animals active or nestling, sometimes sessile, but rarely sedentary burrowers, rarely inequivalve, usually possessing a hinge plate and a pallial sinus. The sexes usually separate." (Dall.)

**Superfamily Cyrenacea.**

"Cypricardians which have become specialized for fresh or brackish water conditions, and, as usual in such cases, have developed great variability of character." (Dall.)

**FAMILY SPHÆRIIDÆ.\***

"Anatomy much as in *Cyrenidæ*, except that the siphons are separate and plain, the branchial sometimes not complete below; the foot prolonged ventrally, narrow, grooved, byssiferous when young; monoecious, the nepionic young incubated in a marsupium formed by the inner limb of the ctenidia; confined to fresh water.

"Shell as in *Cyrenidæ*, but small, with a feeble, short ligament, a simple pallial line, no hinge plate; the cardinal teeth (usually two in each valve) variable, very thin, often nearly parallel to the hinge-margin or defective in part of the series; the laterals in *Cyrenidæ* distinct; the nepionic stage of the shell often conspicuous on the beaks." (Dall.)

**GENUS SPHÆRIUM Scopoli, 1777.**

*Sphærim* SCOPOLI, *Introduct. ad Hist. Nat.*, p. 397, 1777.

*Cyclas* BRUGUIERE, *Encyc. Méth.*, p. 301, 1792.

"*Shell*: Thin, oval or suborbicular, inflated, covered by a greenish epidermis; cardinal teeth very small or rudimentary,

\*Dall, *Trans. Wagn. Free Institute of Sci.*, Vol. III., pt. iii., p. 540.

one more or less bifurcated, one in the right and two oblique ones in the left valve; lateral teeth compressed, lamelliform, the anterior shortest; ligament short; margins plain; muscular impressions scarcely apparent, submarginal; pallial impression simple.

"*Animal*: Oval, subglobular; mantle margins plain; siphons unequal, not ciliated, short, only united at the base, the branchial one largest and longest; mouth small, oval, transverse; branchiæ large, unequal, united behind, the inner ones largest; foot tongue shaped, triangular, flattened, very extensible." (Tryon.) \*+

"Posterior part of shell somewhat longer than anterior; shell and hinge comparatively stout; beaks rounded without caps." (Sterki, in lit. )

The cardinal teeth of *Sphærium* (Fig. 10A) are very interesting, and, generally, quite constant in form. In the right valve

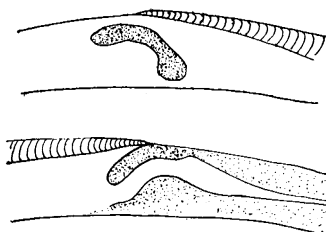


FIG. 10A.

Cardinal Teeth of *SPHÆRIUM STRIATINUM* Lam. (x 50). Upper figure, right valve; lower figure, left valve.

there is a single, arched tooth, which is placed so that one end of the arch is near the dorsal margin of the hinge plate, and the other, somewhat bulb shaped, is near the ventral margin. This tooth fits in between two peculiar teeth in the left valve. One tooth (the upper) extends from the dorsal margin, in a slight curve to the center of the hinge plate. The tooth is narrow and elevated. Near the ventral margin is placed the second tooth, which is elevated, pyramidal and larger than the upper one. The lateral teeth are placed on either side of the cardinal in each valve, two teeth (single) being in the left valve and four

\*Structural and Systematic Conchology, Vol. III., p. 186.

+For a good account of the anatomy of *Sphærium* see Proc. Iowa Acad. of Sci., Vol. III., p. 173, 1895, a paper by Mr. Gilman A. Drew.

(double) teeth in the right valve. They are generally long, lamellar and elevated, and either straight or curved.

*Distribution:* North and South America, Europe, Oceanica, Asia, Africa, New Zealand, East Indies and Madagascar.

The young of both *Sphærium* and *Pisidium* are contained in the inner gill and are of gigantic size as compared with that of the parent, sometimes being one-sixth the length of the adult. When born they "are very active, climbing about submerged plants and often suspending themselves by byssal threads." (Tryon.) The genus is very plentifully distributed, the species being very numerous in individuals. The group is hermaphroditic.

#### KEY TO SPECIES OF SPHÆRIUM AND CALYCVLINA.

- A. Shell solid, epidermis dark.
  - a. Umbones situated anterior of the center of the shell, giving it a transversely elongated outline.
    - 1. Shell trigonal, umbones elevated and inflated, almost smooth.....*solidulum*
    - 2. Shell oval, umbones not as much elevated as 1, very full, coarsely ridged..... *stamineum*
    - 3. Shell transversely elongated, umbones small, depressed, almost smooth..... *striatinum*
  - b. Umbones situated near the center of the shell, depressed; shell transversely oval.....*simile*
- B. Shell fragile, epidermis light.
  - a. Shell transverse.
    - 1. Shell very transverse, umbones elevated and placed well toward the anterior end..... *transversum*
    - 2. Shell transversely oval, umbones depressed and placed centrally.....*fabale*
  - b. Shell rhombic.
    - 1. Shell rhombic-ovate, posterior end squarely truncated, umbones placed near the center..... *truncatum*
    - 2. Shell much inflated, rhombic-orbicular, posterior margin truncated, very high compared with the anterior margin, beaks a trifle anterior, subangulate..... *securum*
  - c. Shell oval.
    - 1. Shell somewhat inflated, small, ends rounded.....*occidentale*
    - 2. Shell compressed, large, posterior end truncated.....*partumeium*

#### 37. *Sphærium solidulum* Prime, pl. xxvii., fig. 4.

*Cyclas solidula* PRIME, Proc. Bost. Soc. H. N., Vol. IV., p. 158, 1851.

*Cyclas distorta* PRIME, 1. c., p. 158, 1851.

*Shell:* Of good size, inflated, very solid, inequilateral, trigonal; umbones inflated, somewhat elevated, placed anterior to

the center of the shell, marked by rather coarse ridges; dorsal margin strongly arcuate, ventral border rounded, posterior margin long, obtusely triangular, the umbonal slope rounded; anterior margin rounded; surface shining, growth lines coarse, crowded; fine lines may be seen between the coarse ones when viewed with a lens; color varying from dark horn to yellowish brown, sometimes marked by large blotches of both colors on the shell and with a yellowish line bordering the ventral margin; ligament thin, dark brown; cardinal teeth very small, a single lamellar, elevated tooth, which forms a long, arched projection beneath the point of the beak in the right valve, and two elevated, curved, thin teeth in the left valve, one just beneath the beak and one midway between hinge margins; the hinge line in both valves is thickened and extends from the lateral to the cardinal teeth, rising to meet the latter; lateral teeth situated on either side of the cardinals in each valve, short, elevated, thick, curved, double in the right and single in the left valve; muscle scars and pallial line distinct, the latter crenulated; nacre bluish white, darker near the cavity of the beaks, which are deep.

Length, 11.00; height, 8.75; breadth, 7.00 mill. (12458).

*Animal*: Not observed.

*Distribution*: New York to Iowa, Wisconsin to Louisiana and New Mexico.

*Geological distribution*: Pleistocene.

*Habitat*: Found in the smaller rivers and creeks, on a muddy bottom.

*Remarks*: This species is easily known by its strongly trigonal outline and solid shell. It is distinguished from *stamineum* by its less distinctly marked umbones and more trigonal form; *striatinum* is much more transverse and is very much more compressed, while the umbones are smaller, and the shell is smaller than *stamineum* generally. It does not seem to be a common shell, and is confined to the Desplaines River drainage and Lake Michigan.

**38. *Sphærium stamineum*** Conrad, pl. xxvii., fig. 1.

*Cyclas staminea* CONRAD, Amer. Jour. Sci. and Arts, 1st series, Vol. XXV., p. 342, pl. i., fig. 5, 1834.

*Cyclas fuscata* RAFINESQUE, PRIME, Proc. Bost. Soc. N. H., Vol. IV., p. 281, 1852.

*Cyclas bulbosa* ANTHONY, PRIME, 1. c., p. 283, 1852.



*Shell:* Large, inflated, rather solid, inequilateral, oval; umbones depressed, inflated, placed anterior to the center of the shell, marked by a number of coarse, rounded, even ridges, which cause the beaks to stand out prominently; umbonal slopes rounded; dorsal margin slightly arched, ventral border rounded; anterior and posterior margins rounded or subtruncated; surface shining, marked by very strong lines of growth; color yellowish or brownish, sometimes dark horn color; ligament weak, dark horn color; cardinal teeth very small, a single, elevated arched tooth situated just beneath the beak, the two arches of unequal length, in the right valve, and two narrow, solid, elevated, pyramidal teeth which are placed as in *solidulum*, the tooth near the ventral border being smaller and more elevated, in the left valve; the hinge line is a trifle thickened; lateral teeth on each side of the cardinals short, thick, solid, elevated, serrated, double in the right and single in the left valve; muscle scars and pallial line faint; nacre bluish white, with zones of very dark purple or horn color.

Length, 14.00; height, 11.00; breadth, 9.00 mill. (9885).

" 10.50; " 8.00; " 5.50 " (8510) .

" 10.50; " 9.00; " 7.00 " (9882).

" 9.00; " 8.00; " 5.50 " (8511).

*Animal:* Bluish or whitish, transparent, yellowish about the base of the siphons and brownish on the dorsal part near the liver and heart; mantle lobes thin and transparent, edged with brownish yellow or yellowish white, very muscular; siphons long, united only at base, ventral very large and longest, not ciliated; adductor muscles not large and rather weak; foot retractor and protractor muscle well developed; foot long and digitiform, transparent, and capable of extension more than the length of the shell; it is thrust from a cleft in the mantle about the center of the ventral border of the shell; ctenidia large, the outer the smallest, rounded before and behind, united above; labial palpi long and narrow, ciliated, united at base, bluish white in color; pericardium situated well on the dorsal surface; heart very plainly seen, beats regular, fifty-seven per minute.

*Distribution:* New England west to Arkansas and Iowa, Illinois south to Alabama and Louisiana.

*Geological distribution:* Pleistocene.

*Habitat:* In small creeks, ponds and rivers, buried in black, slimy mud to a depth of several inches.

*Remarks:* This is a common and widely diffused species, occurring in all parts of the area under discussion. Particularly large and fine specimens are found in the DuPage River near Lisle. Some little variation exists, principally in the relative length and height. It may easily be recognized by its inequilateral form and very heavily marked umbones.

On July 25, 1896, the writer found young in the inner gills, measuring from two to five or six millimeters in length, three or four being found in each gill. The animal is quite active, moving by a series of jerks. Progression is effected by means of the foot, which is thrust out to its fullest extent and the shell drawn after it. It is very interesting to watch this species in an aquarium and notice its quick, jerky motions. It thrives well in captivity, and is very well adapted for anatomical investigations, owing to its large size.

**39. *Sphærium simile* Say, pl. xxvii. , fig. 3.**

*Cyclas similis* SAY, Nich. Encyc., Am. Ed., Vol. II., pl. i., fig. 9, 1817.

*Cyclas sulcata* LAMARCK, An. sans Vert., Vol. V., p. 560, 1818.

*Cyclas Sarratogea* LAMARCK, l. c., p. 560, 1818.

*Cyclas lasmampsis* RAFINESQUE, An. Gen. Sci. Phys. et Nat., Vol. V. , p. 319, pl. lxxxii., figs. 19, 20, 1820.

*Cyclas solida* DEKAY, Moll. of N. Y. , p. 229, pl. xxv. fig. 265, 1843.

*Cyclas gigantea* PRIME, Proc. Bost. Soc. N. H., Vol. IV., p. 157, 1851.

*Cyclas ponderosa* PRIME, l. c., p. 157, 1851.

*Shell:* Large, inflated, rather solid, almost equilateral, transversely oval; umbones depressed, inflated, placed a trifle anterior to the center of the shell, marked by heavy ridges, but not so coarse as in *stamineum*; dorsal margin very nearly straight, ventral border broadly curved; anterior and posterior margins almost equal, the posterior a little longer than the anterior, the two margins rounded; umbonal slopes rounded; surface shining, growth lines coarse; color dark brown, sometimes with a reddish tinge; ligament weak, very dark horn or black; cardinal teeth small, a single, long, stout, elevated, arched tooth in the right valve, and two stout, elevated teeth in the left valve, the upper tooth being short and curved and the lower tooth long and almost straight; one specimen (10882) seems to have the teeth in the right valve double and placed like those of the left valve; the teeth are sometimes very long and lamellar (8513); lateral teeth double in the right and single in the left valve, short, elevated, lamellar, nearly straight; muscle scars

and pallial line faintly impressed; nacre bluish; cavity of the beaks shallow.

Length, 16.50; height, 11.75; breadth, 9.00 mill. (8513).

" 15.50; " 12.00; " 9.00 " (8513).

" 18.00; " 13.00; " 10.00 " (12460).

*Animal*: Not observed.

*Distribution*: United States and Southern Canada.

*Geological distribution*: Pleistocene.

*Habitat*: In rivers and lakes, in soft mud.

*Remarks*: The hinge teeth are arranged very peculiarly in this species, the laterals being in a direct line with the cardinals, and not at right angles to them, as in the previous species. It is one of the largest of the genus and distinguished from the related species by its transversely oval outline, its peculiarly placed teeth, and its umbonal marking, which is intermediate between *solidulum* and *stamineum*. The umbones are also placed very near the center of the shell. The species does not seem common, although found in the southern, northern and western regions, under circumstances which should be conducive to their multiplication.

#### 40. *Sphærium striatinum* Lamarck, pl. xxvii., fig. 2.

*Cyclas striatina* LAM., An. sans Vert., Vol. V., p. 560, 1818.

*Cyclas edentula* SAY, New Harmony Dissem., p. 356, 1829.

*Cyclas albula* PRIME, Proc. Bost. Soc. N. H., Vol. IV., p. 155, 1851.

*Cyclas tenuistriata* PRIME, 1. c., p. 156, 1851.

*Cyclas acuminata* PRIME, 1. c., p. 158, 1851.

*Cycles inornata* PRIME, 1. c., p. 159, 1851.

*Cyclas simplex* PRIME, 1. c., p. 159, 1851.

*Cyclas modesta* PRIME, 1. c., p. 159, 1851.

*Shell*: Of medium size, not much inflated, solid, transversely elongated, very inequilateral; umbones depressed, full, placed anterior to the center of the shell, marked by numerous fine ridges, which are so fine in some specimens that the beaks appear smooth; dorsal margin arcuate; ventral margin rounded; posterior margin obtusely triangular; anterior margin broadly rounded; umbonal slope rounded, the posterior inclined to angular; surface shining, lines of growth coarse, but not so much so as in *stamineum*; color greenish yellow, varying to dark horn in some specimens; ligament weak, dark horn colored; cardinal teeth, small, those in the left valve unequal, one placed near the dorsal margin of the hinge plate, small, and extending diagonally toward the ventral margin, and one placed near the

ventral border of the hinge plate, large, pyramidal, elevated that in the right valve arched, the left angle of the arch being shorter than the right, elevated, long, thick; lateral teeth double in the right and single in the left valve, short, elevated, stout, but slightly curved; muscle scars very faint; cavity of the beaks shallow; nacre bluish or whitish.

Length, 10.50; height, 7.50; breadth, 5.50 mill. (8510).

" 10.50; " 8.00; " 6.00 " (8510).

" 9.00; " 7.00; " 5.00 " (8514).

*Animal*: Not observed.

*Distribution*: New England west to California, Canada south to Louisiana, Alabama and Florida.

*Geological distribution*: Pleistocene.

*Habitat*: Same as for *stamineum*.

*Remarks*: This species is closely allied to *stamineum* but may be distinguished by its depressed beaks, more elongate outline and fainter growth lines, especially about the beak, which is very coarsely sulcated in *stamineum*. The species is as numerous in individuals as the latter species and resembles it also in habitat, burying to a considerable depth in the soft mud. It is universally distributed. It has been found fossil in a sand bank near the lake shore, east of Sheridan Drive and north of Graceland Avenue, by Mr. Jensen.

#### 41. *Sphærium fabale* Prime, pl. xxvii., fig. 7.

*Cyclas fabalis* PRIME, Proc. Bost. Soc. N. H., Vol. IV., p. 159, 1851.

*Cyclas castanea* PRIME, l. c., Vol. IV., p. 160, 1851.

*Cyclas sulculosa* DE CHARPENTIER, MSS., 1851.

*Shell*: Of good size, transversely oval, somewhat compressed, almost equilateral, thin and fragile to quite solid; anterior and posterior margins rounded; ventral margin curved; dorsal margin slightly curved; umbones depressed, almost flush with the hinge line, placed near the center of the shell and quite heavily marked and regular; umbonal slopes gently rounded; surface smooth and shining in young or half grown specimens but dull in old examples; lines of growth typically very coarse and distinct, but finer in some specimens; color light green, yellowish or blackish, the latter a marked character in old specimens; ligament weak, color varying with the shell; cardinal teeth small, those in the left valve unequal, one placed near the dorsal margin and extending from the latter to a point midway between the dorsal and ventral margins of

the hinge plate, and one placed near the ventral margin of the hinge plate; the dorsal tooth is nearly straight while the ventral tooth is very arcuate; in the right valve there is a single, large, arched tooth which extends from the center to the ventral border of the hinge plate, it is large at either end and small in the middle; lateral teeth double in the right and single in the left valve, rather small, elevated, pyramidal, slightly curved; hinge line rather solid; muscle scars indistinct; cavity of the beaks shallow; anterior bluish.

Length, 11.00; height, 9.00; breadth, 5.50 mill.

" 9.50; " 7.50; " 5.00 "

" 9.50; " 7.00; " 4.75 "

*Animal*: Not observed. Siphons said by Prime to be crimson.

*Distribution*: New England west to Iowa, Canada south to Louisiana.

*Geological distribution*: Pleistocene.

*Habitat*: In the large lakes, on a muddy bottom, in rather deep water.

*Remarks*: *Fabale* has been found at but one locality thus far, but probably occurs anywhere along the shore of Lake Michigan. Its only locality, Miller's, Ind., is at the extreme southern end of Lake Michigan. This interesting region is said by Prof. Garriott to be the most wind-swept locality in the Chicago area. This fact accounts for the enormous quantity of sea wrack which lines the shore at this point and which is not to be found in such profusion anywhere else along the shore. This sea wrack has proven prolific collecting ground for molluscan life.

The present species is very variable, running from perfectly smooth to coarsely striated and varying in color from yellow to black. It may always be known by its depressed umbones.

#### 42. *Sphaerium occidentale* Prime, pl. xxvii., fig. 10.

*Cyclas ovalis* PRIME, Proc. Bost. Soc. N. H., Vol. IV., p. 276, 1852 (Pre-occupied).

*Sphaerium occidentale* PRIME, l. c., Vol. V., p. 122, 1855.

*Shell*: Small, inflated, fragile, equilateral; umbones prominent but not much elevated, inflated, placed centrally, marked by very fine lines; dorsal and ventral margins rounded; anterior and posterior margins rounded; umbonal slopes rounded; sur-

face shining, marked by very fine lines of growth; color light horn, sometimes darker; ligament as usual; cardinal teeth small, a single, elevated, lamellar, curved tooth in the right valve, the posterior curve of which is longer than the anterior and is club shaped, and two teeth in the left valve, that near the ventral border of the hinge plate being elevated and pyramidal, that on the dorsal border being long, lamellar, depressed, and curved, as in the preceding species; lateral teeth short, elevated, curved, single in the left and double in the right valve; muscle scars scarcely discernible; cavity of the beaks shallow; nacre light purplish or bluish.

Length, 7.50; height, 7.00; breadth, 4.50 mill. (8456).

" 6.00; " 5.00; " 3.50 " (8456).

*Animal*: Transparent, whitish, reddish brown near the umbones; mantle white, thin and transparent; siphons of medium length, united at base; ctenidia large, wide, rounded, united above; labial palpi long and narrow, united at base; foot large, long and narrow, extended from the center of the shell; the shell is so transparent that most of the organs may be seen through it when held between the observer and the light.

*Distribution*: New England west to Washington, Canada south to Louisiana.

*Geological distribution*: Pleistocene.

*Habitat*: Found in lakes and rivers, in soft mud, either on the surface or buried.

*Remarks*: This species is distinguished by its oval outline, which is more regular than that of any other *sphærium* found here. It is very common, and when found at all is usually represented by hundreds of individuals.

#### GENUS **CALYCULINA** Clessin.

"Posterior part longer, or scarcely so, higher than anterior; shell very thin and fragile; hinge very fine." (Sterki in lit.)

#### **43. Calyculina transversa** Say, pl. xxvii., fig. 5.

*Cyclas transversa* SAY, New. Harm. Dissem., Vol. II., p. 356, 1829.

*Cyclas detruncata* PRIME, Proc. Bost. Soc. N. H., Vol. IV., p. 155, 1851.

*Cyclas gracile* PRIME, l. c., Vol. IV., p. 156, 1851.

*Cyclas constricta* ANTHONY, l. c., Vol. IV., p. 274, 1852.

*Shell*: Thin, of good size, inflated, inequilateral, transversely oblong, translucent; umbones elevated, not large, full, calyculate, placed anterior to the center of the shell, smooth and

shining; dorsal margin straight; ventral margin broadly rounded; posterior margin subtruncated; anterior margin rounded; umbonal slopes rounded; surface smooth and shining, lines of growth very fine; color light yellowish, sometimes darker; ligament very thin, light brown; cardinal teeth small, a single, arched, elevated, lamellar tooth situated near the ventral margin of the hinge plate in the right valve, and two elevated teeth in the left valve, of which the dorsal is situated near the center of the hinge plate, arched, lamellar, and the ventral is situated near the lower margin of the hinge plate, and is elevated, pyramidal and solid; lateral teeth lamellar, straight, elevated, single in the left and double in the right valve; muscle scars very faint; cavity of the beaks shallow; nacre bluish white.

Length, 12.50; height, 9.00; breadth, 7.00 mill. (9965).

" 11.50; " 8.00; " 6.00 " (9965).

*Animal*: White, greenish about the liver; mantle lobes very thin and transparent; siphons rather short, narrow, about equal in size, united only at base, pinkish in color; foot very long and narrow, white, capable of great extension, and extended through a cleft in the mantle near the anterior end of the ventral portion; ctenidia large, white, rounded, united above; labial palpi long and narrow, united at base, white.

*Distribution*: New York west to Arkansas, Canada south to Alabama and Louisiana.

*Geological distribution*: Pleistocene.

*Habitat*: Found in rivers, ponds and lakes, in soft mud, either on the surface or buried to a considerable depth.

*Remarks*: This is a distinct little shell, and can be confounded with no other. It is a common and abundant species, and may be seen on any pleasant day jerking its way over the muddy bottom of our rivers. Its transverse outline differs from that of any other species found in this area, and will at once distinguish it. The species is found in the northern and western regions.

#### 44. *Calyculina truncata* Linsley, pl. xxvii., fig. 8.

*Cyclas calyculata* DRAPARNAUD, C. B. ADAMS, Amer. Jour. Sci. and Arts, 2d series, Vol. XL., p. 277, 1841.

*Cyclas truncata* LINSLEY, Amer. Jour. Sci. and Arts., 3d series, Vol. VI., p. 234, fig. 3, 1848.

*Cyclas lenticula* GOULD, Proc. Bost. Soc. N. H., Vol. III., p. 256, 1850.

*Cyclas pellucida* PRIME, STIMPSON, Shells of New England, p. 16, 1851.

*Shell*: Very fragile, small, inflated, almost equilateral, rhombic-ovate, translucent; umbones prominent, elevated, full, calyculate, approximating, placed centrally, smooth and shining; dorsal margin straight; ventral margin broadly rounded; anterior margin rounded; posterior margin sharply truncated, rounded on the ventral part; umbonal slopes rounded; surface smooth and shining, lines of growth very fine; color light yellowish green or greenish horn with a zone of yellow bordering the ventral margin of the valve; ligament weak, light horn color; cardinal teeth small, a single, elevated, lamellar, arched tooth in the right valve, and two teeth in the left valve, the ventral tooth pyramidal, elevated, the dorsal tooth long, lamellar, curved, and elevated; lateral teeth long, lamellar, elevated, straight, one in the left valve and two in the right valve; muscle scars scarcely visible; cavity of the beaks shallow; nacre light bluish with a yellow zone on the ventral border.

Length, 9.25; height, 7.50; breadth, 5.00 mill. (12464).

" 7.50; " 6.50; " 3.50 " (12464).

*Animal*: Not observed.

*Distribution*: New England west to Illinois and Wisconsin, Canada south to Kentucky.

*Geological distribution*: Pleistocene.

*Habitat*: In small ponds and sheltered parts of rivers, in soft, sticky mud.

*Remarks*: This species is very like *S. transversa*, but is shorter in comparison with its height, is rhombic in form and the beaks are placed centrally. The two species belong to a natural group of which *transversa* is the leading form. It is not as common as *transversa* and is confined to the lower part of the western region.

#### 45. *Calyculina securis* Prime, pl. xxvii., fig. 9.

*Cyclas securis* PRIME, Proc. Bost. Soc. Nat. His., Vol. IV., p. 160, 1851; Ann. N. Y. Lyceum, Vol. V., p. 218, pl. vi., 1851.

*Cyclas cardissa* PRIME, Proc. Bost. Soc. N. H., Vol. IV., p. 160, 1851.

*Cyclas crocea* LEWIS, l. c., Vol. V., p. 25, 1854.

*Shell*: Small, fragile, but stouter than the two previous species, inflated, inequilateral, rhombic-orbicular; umbones elevated, full, much inflated, calyculate, approximate, placed a trifle anteriorly; marked by very fine lines of growth; dorsal margin arched; ventral margin rounded; anterior margin rounded, posterior truncated; umbonal slopes rounded, sub-



angulate posteriorly; surface shining, lines of growth very faint; color varying from bright yellow to greenish horn, sometimes very dark horn; ligament as usual; cardinal teeth very small, a single, long, elevated, lamellar, arched tooth in the right valve, which has a large pyramidal projection near the anterior end giving the hinge the appearance of a double tooth, and two teeth in the left valve, one near the ventral margin of the hinge plate, elevated, pyramidal, and one near the dorsal border, lamellar, depressed, curved, extending diagonally toward the ventral border; lateral teeth long, lamellar, elevated, slightly curved, one in the left valve and two in the right; muscle scars faint; cavity of the beaks deep; nacre bluish white, darker near the postero-ventral portion, lighter in yellowish specimens

Length, 6.00; height, 5.00; breadth, 3.00 mill. (12465).

" 5.50; " 4.50; " 2.50 " (12465).

*Animal*: Not observed.

*Distribution*: New England west to Michigan, Canada south to Kentucky.

*Geological distribution*: Pleistocene.

*Habitat*: Same as *S. truncata*.

*Remarks*: A species at once distinguished by its rhombic-orbicular outline and inflated beaks and shell. It is the smallest *Shærium* found in this area, and is wider in proportion to its length than any other species. It does not seem to be very common, and, like the last species, is confined to the southwestern part of the western region.

#### 46. *Calyculina partumeia* Say, pl. xxvii., fig. 6.

*Cyclas partumeia* SAY, Journ. Phil. Acad., Vol. II., p. 380, 1822.

*Cyclas cornea*, var. 2, LAM., An. sans Vert., Vol. V., p. 558, 1818.

*Cyclas orbicularia* BARRATT, Amer. Journ. Sci. and Arts, Vol. XLVIII., p. 276, 1845.

*Cyclas mirabilis* PRIME, Proc. Bost. Soc. N. H., Vol. IV., p. 157, 1851.

*Cyclas cærulea* PRIME, l. c., p. 161, 1851.

*Cyclas eburnea* ANTHONY, l. c., p. 279, 1852.

*Shell*: Of good size, inflated, fragile, very nearly equilateral, pellucid; umbones elevated, inflated, of good size, placed near the center of the shell, calyculate, very finely marked by growth lines; dorsal margin slightly arched, ventral rounded; anterior margin broadly rounded, posterior roundly truncated; umbonal slopes rounded; surface shining, polished, marked by very fine growth lines; color greenish horn or yellowish, with frequently a broad zone of dark purple on the ventral border;

ligaments slight; cardinal teeth small, a single, long, elevated, curved tooth placed near the dorsal border of the hinge plate in the right valve, and two teeth in the left valve, the dorsal tooth being long, elevated, lamellar and curved, and the ventral tooth elevated, pyramidal and stout; lateral teeth long and straight, elevated, lamellar, double in the right and single in the left valve; the anterior part of the valve is rounded, but the posterior forms a decided angle with the hinge line; muscle scars barely visible; cavity of the beaks deep; nacre horn color, with a blue zone on the ventral margin.

Length, 6.00; height, 5.50; breadth, 3.00 mill. (8458).

" 5.50; " 5.00; " 3.00 " (10093).

" 8.50; " 7.75; " 4.50 " (12466).

*Animal*: Similar to that of *S. occidentale*.

*Distribution*: New England west to Iowa, Wisconsin south to Alabama, Louisiana and Florida.

*Geological distribution*: Pleistocene.

*Habitat*: Found in ponds and rivers, buried in black mud.

*Remarks*: This species is closely allied to *S. occidentale* Prime, but may be distinguished by its larger size, truncated posterior border and general rounded oval outline. It is one of our commonest species, and also one of the most beautiful of the genus. *Partumeia* is found in almost every part of the area, and is the most widely distributed of any species in the genus. It is a very handsome species when at its best, the shell being so thin that the animal may easily be seen through it.

#### GENUS **PISIDIUM** Pfeiffer.

*"Shell*: Small, rounded-oval, inequilateral, anterior side longer; beaks terminal; cardinal teeth double, at times united, situated immediately under the beaks; lateral teeth elongated, lamelliform, double in the right valve, single in the left valve; ligament always on the shorter side.

*"Animal*: Elongate-oval, compressed laterally; lobes of the mantle without tentacles, united posteriorly into a single, short siphonal tube; oral aperture small, tentacles of the mouth triangular, elongated; gills of medium size; foot small, tongue shaped, capable of great extension." (Prime.\*)

"Posterior part of shell shorter than anterior; siphons quite short." (Sterki, in lit.)

---

\*Monograph of American Corbiculadæ, p. 59.

*Pisidium* differs from *Sphærium* principally in its siphonal tubes, which are united in the former for their whole distance, and in the latter are united only at the base. The foot also differs, being similar in some respects to *Cardium*. (Prime.) The beaks in *Pisidium* are placed near the *posterior* end, while in *Sphærium* they are placed centrally or near the *anterior* end.

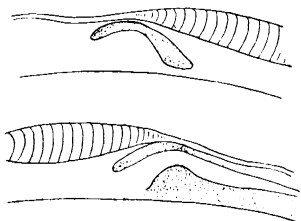


FIG. 11.

Cardinal teeth of *PISIDIUM COMPRESSUM* Prime (x 50, original). Upper figure, right valve; lower figure, left valve.

The mode of reproduction is the same in both genera. *Pisidia* may be more profitably collected during the spring and summer, "from the middle of April to the early part of July,"\* this being the breeding season.

The cardinal teeth are sometimes quite similar to (Fig. 11) and again quite different (Fig. 12) from those of *Sphærium*. The

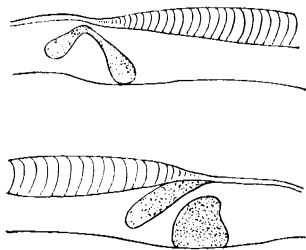


FIG. 12.

Cardinal teeth of *PISIDIUM VIRGINICUM* Bourg. (x 50, original). Upper figure, right valve; lower figure, left valve.

teeth in *Pisidium* are generally more elongated than those of *Sphærium*. In one type (Fig. 11) the single cardinal in the right valve is long, narrow and curved, the lower part of the curve being thicker than the upper part, and placed near the ventral border of the hinge plate. The upper tooth in the left valve is

\*Prime, Monograph, p. 61.

long, very narrow and curved, and extends to a point about the center of the hinge plate; the lower tooth is more or less pyramidal, elevated and somewhat lamellar. In the second type (Fig. 12) the single right cardinal is very much arched, swollen at both ends of the arch, the right arm being the longer. The upper left cardinal is long and thick, elevated, lamelliform, and extends nearly to the ventral border of the hinge plate; the second left tooth is more or less rounded, pyramidal, elevated, and extends well toward the dorsal margin of the hinge plate.

*Distribution* : North and South America, Europe, New Zealand, India, Iceland, Greenland.

#### KEY TO SPECIES OF PISIDIUM.

- a. Umbones placed very near the center of the shell, which is elongated oval in form..... *abditum*
  - 1. Differs from "a" in being smaller, shorter and higher, the beaks less full, and the sculpture finer and more polished. .... *politum*
- b. Umbones placed near the posterior end of the shell.
  - 1. Shell very oblique, posterior end short, rounded, anterior end long, obtusely triangular, larger than (2)..... *virginicum*
  - 2. Shell trigonal and triangular, more compressed than (1), posterior end short and rounded, anterior end much produced, beaks somewhat elevated and compressed..... *compressum*

#### 47. *Pisidium Abditum* Haldeman, pl. xxviii., fig. 1.

*Pisidium abditum* HALDEMAN, Proc. Phil. Acad., p. 53, 1841.

*Cyclas major* C. B. ADAMS, Proc. Bost. Soc. N. H., p. 48, 1841.

*Pisidium tenellum* GOULD, Agassiz, Lake Superior, p. 235, 1848.

*Pisidium minus* STIMPSON, Shells of New England, p. 16, 1851.

*Pisidium obscurum* PRIME, Proc. Bost. Soc. N. H., Vol. IV., p. 161, 1851.

*Pisidium kurtzi* PRIME, 1. c , p. 162, 1851.

*Pisidium zonatum* PRIME, 1. c., p. 162, 1851.

*Pisidium rubellum* PRIME, 1. c., p. 163, 1851.

*Pisidium regulare* PRIME, Bost. Journ. Nat. Hist., Vol. VI., p. 363, pl. xii., fig. 11, 12, 1852.

*Pisidium notatum* PRIME, 1. c., p. 365, pl. xii., fig. 20-22, 1852.

*Pisidium arcuatum* PRIME, 1. c., p. 364, pl. xii., fig. 14-16, 1852.

*Pisidium resartum* INGALLS, in litt., 1855.

*Pisidium rubrum* LEWIS, in litt., 1855.

*Pisidium plenum* LEWIS, in litt., 1855.

*Shell*: Large (for the genus), inflated, rather solid, somewhat inequilateral, elongate-oval; umbones slightly raised, full, placed a little posterior of the center, very rough, sometimes showing growth lines plainly, but generally covered with

little prominences; dorsal and ventral margins rounded; anterior margin long, broadly rounded; posterior margin short, rounded; umbonal slopes rounded; surface shining, lines of growth faint; color very light horn or yellowish; ligament short, dark horn; cardinal teeth small, a single, lamellar, elevated, arched tooth in the right valve; the right arm of the arch is longer than the left and reaches nearly to the ventral border of the hinge plate; the left valve is armed with two cardinal teeth, the dorsal tooth being very long, lamellar, elevated and peculiarly bent at the distal end; the ventral tooth is large, elevated and more or less pyramidal; lateral teeth strong, curved, elevated, but projecting much above the edge of the valve, double in the right and single in the left valve; cavity of the beaks shallow.

Length, 4.25; height, 3.00; breadth, 2.50 mill. (9883).

*Animal*: Not observed.

*Distribution*: New England west to California, Canada south to Louisiana, Florida and Honduras.

*Geological distribution*: Not known, probably Pleistocene.

*Habitat*: Found in the smaller lakes and streams, buried in soft, black mud, or on aquatic plants.

*Remarks*: This is a distinct and abundant species, distinguished by its elongated ovate outline. It is quite abundant and is universally distributed.

**48. *Pisidium virginicum*** Bourguignat, pl. xxviii., fig. 2.

*Tellina virginica* GMELIN, Syst. Nat., pp. 32, 36, pl. clix., fig. 15, 1788.

*Tellina pusella* (pars) DILLWYN, Cat., Vol. II., p. 106, 1817.

*Cyclas dubia* SAY, Nich. Encyc., 1st Am. Ed. II., p. 4, pl. i., fig. 10, 1817.

*Physmoda aequalis* RAFINESQUE, Ann. Gen. Sci. Phys. et Nat., Vol. V., p. 319, 1820.

*Pisidium abruptum* HALDEMAN, Proc. Phil. Acad., p. 53, 1841.

*Pisidium virginicum* BOURGUIGNAT, Rev. Mag. Zoöl., 1854.

*Shell*: Of good size, thick, not much inflated, inequilateral, very oblique; umbones not much elevated, prominent, full, placed near the posterior end of the shell, marked by growth lines; dorsal margin almost straight; ventral margin rounded; anterior margin broadly triangular, long; posterior margin short and rounded, sometimes appearing as if truncated; umbonal slopes rounded, sometimes inclining to angular anteriorly; surface shining, marked by heavy growth lines which are faint on the protoconch; color dark horn in old specimens, lighter in younger specimens, and zoned with light yellowish, especially

near the ventral border; ligament as usual; cardinal teeth small, a single, elevated, arched tooth in the right valve, of which the right arm of the arch is the longest and reaches to the ventral border of the hinge plate; both arms are swollen at the ends and the arch forms as a whole, a letter V reversed; the left valve is armed with two teeth, the dorsal being thick, long, elevated and straight, and reaches nearly to the ventral edge of the hinge plate; the ventral tooth is large, rounded and pyramidal; lateral teeth strong, curved, elevated, smooth or only slightly striated, those of the left valve projecting strongly above the valve edge, those of the right valve not so much so, but projecting into the cavity of the shell; double in the right and single in the left valve; cavity of the beaks shallow; nacre glossy, inclining to purplish.

Length, 6.00; height, 5.00; breadth, 4.00 mill. (9879).

*Animal*: Not examined.

*Distribution*: New England west to Iowa, Canada south to Louisiana.

*Geological distribution*: Pleistocene.

*Habitat*: Same as *abditum*.

*Remarks*: A species easily recognized by its large size (it is the largest of the genus) and oblique form. It is one of the handsomest of the *Pisidia*. Thus far it has only been found in the southern region. Found fossil in sand banks east of Sheridan Drive and north of Graceland Avenue.

**49. *Pisidium compressum*** Prime, pl. xxviii., fig. 7.

*Cyclas altilis* ANTHONY, in litt., 1847.

*Pisidium compressum* PRIME, Proc. Bost. Soc. N. H., Vol. IV., p. 164, 1851.

*Pisidium cicer* PRIME, Ann. N. Y. Lyc., Vol. VI., p. 65, pl. i., fig. 1, 1853.

*Shell*: Small, solid, inflated, subequilateral, very oblique, trigonal; umbones elevated, drawn up and compressed, placed near the posterior end of the shell, marked by lines of growth; there is a wing shaped appendage on the summit of the beaks; dorsal margin very arcuate; ventral margin rounded; anterior margin long, narrow, produced; posterior margin short and rounded; umbonal slopes rounded; surface shining, marked by coarse growth lines; color yellowish, darker in old specimens; ligament as usual; cardinal teeth small, a single, long, curved tooth extending from near the ventral to the dorsal edge of the hinge plate, the right arm of the arch being long and swollen;

the left valve is armed with a dorsal long, narrow, lamellar, almost straight tooth, extending about half way to the ventral border of the hinge plate, and a large, rounded, pyramidal tooth placed near the ventral border; lateral teeth strong, elevated, curved, the right valve teeth strongly projecting above the valve edge, the left valve teeth not so much so; double in the right and single in the left valve; cavity of the beaks deep.

Length, 3.50; height, 3.00; breadth, 2.50 mill. (9880).

" 4.50; " 4.50; " 3.00 " (12468).

*Animal*: Not observed.

*Distribution*: New England west to California, Canada south to Arizona and New Mexico.

*Geological distribution*: Pleistocene.

*Habitat*: Similar to *abditum*.

*Remarks*: The winged beaks are a peculiarity of this species which will aid in its determination, although the appendages are not always present. Its trigonal form is different from any other species of the genus found in the region under discussion. It is found in both the western and southern regions.

## 50. *Pisidium politum* Sterki, unfigured.

*Pisidium politum* STERKI, The Nautilus, Vol. IX., p. 75, 1895.

"Mussel of medium size, well inflated, rather high, beaks slightly posterior, rather high and prominent, not full but well rounded; scutum and scutellum slightly marked. Superior margin rather short, rather strongly curved; inferior well curved, more so in front than behind; posterior margin distinctly truncated, with a well marked angle where joining the superior, and a less marked, rounded angle where joining the inferior margin; anterior end forming a slight but distinct angle situated rather high up. Surface very finely, irregularly striated, polished; whitish or straw colored, often leaden grayish on the beaks, or even all over. Shell moderately thick; nacre whitish; muscular insertions not very distinct; hinge of essentially the same type as that in *Pis. abditum*.

" Length, 4.0; altitude, 3.4; diameter, 2.4 mill.; 4.7; 4.0; 2.9 mill. from another place.

"*Pis. politum* is rather variable in size, and more so in color as noted above, but so markedly constant in its several habitats that a number of different local forms, or varieties could be described. It has some resemblance with *Pis. abditum* Hald.

and *Pis. variabile* Pr.; from the former it is different by its being somewhat smaller, comparatively shorter and higher, the beaks being less full, the surface finer striated and more polished; from the latter it is distinguished by its smaller size, the beaks being less full, the antero-superior margin less straight, and the angle at the anterior end being situated higher up; the shell is thinner and the hinge less strong, the coloration different. With all these differences appearing only gradual, our *Pisidium* is a good species beyond a doubt and will always be recognized." (Sterki. )

*Distribution:* This species has been found thus far at the following localities: New Philadelphia, Ohio; Philadelphia, Pa.; Grand Rapids, Mich.; Clearwater River and Dallas Lake, Minn.; Joliet, Ill.

*Habitat:* Found in company with *Pis. abditum* and *compressum*. \*

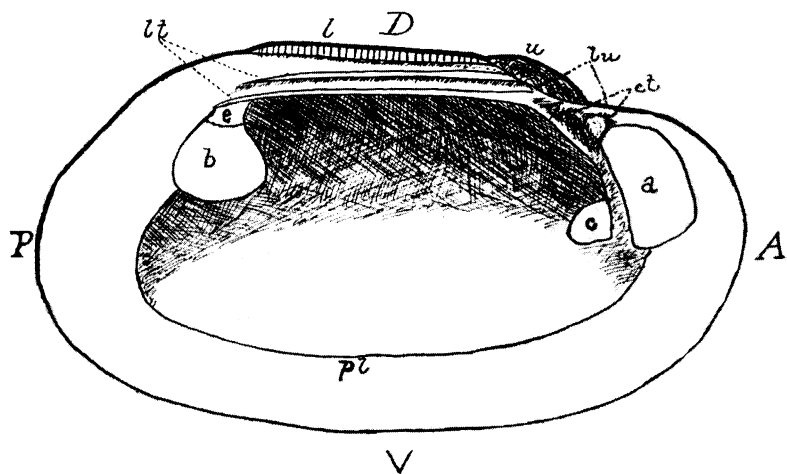
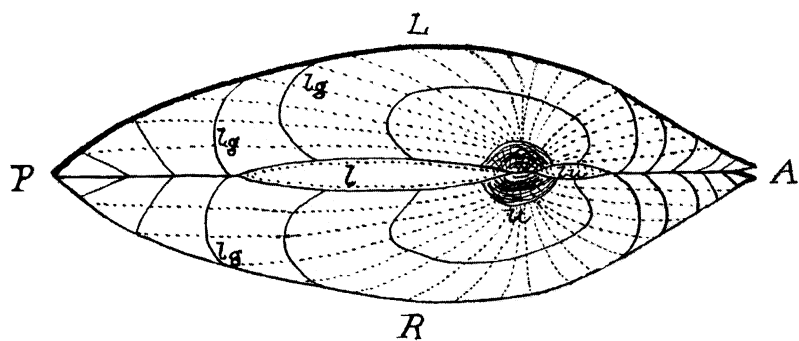
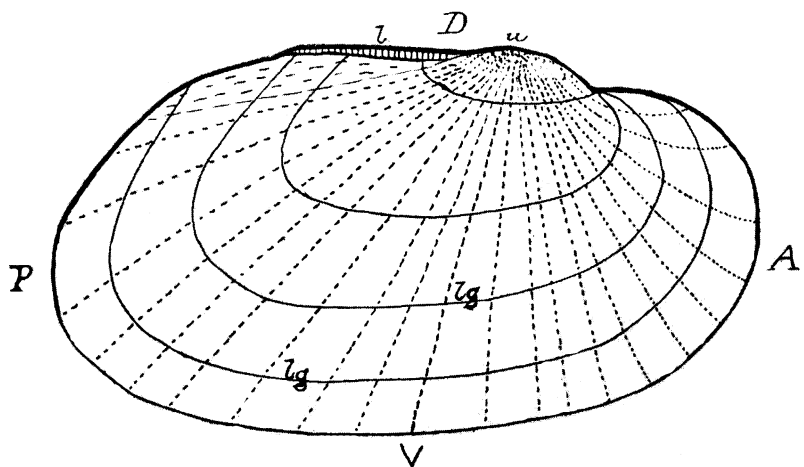
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\*Besides the foregoing there are a number of forms of *Sphæria* and *Pisidia* now in the hands of Dr. V. Sterki, which he has not fully investigated. When these are determined, no doubt many new forms will be added to our fauna.



### EXPLANATION OF PLATE I.

UNIO LUTEOLUS Lamarck, showing different parts of shell. Upper figure, right valve, exterior; middle figure, both valves viewed from above; lower figure, left valve, interior. A, Anterior end. P, Posterior end. D, Dorsal margin. V, Ventral margin. R, Right valve. L, Left valve. a, Anterior adductor muscle-scar (or *cicatrix*). b, Posterior adductor muscle-scar. c, Anterior foot retractor muscle-scar. e, Posterior foot retractor muscle-scar. ct, Cardinal teeth. lt, Lateral teeth. l, Ligament. lg, Lines of growth. lu, Lunule. pl, Pallial line. u, Umbo.

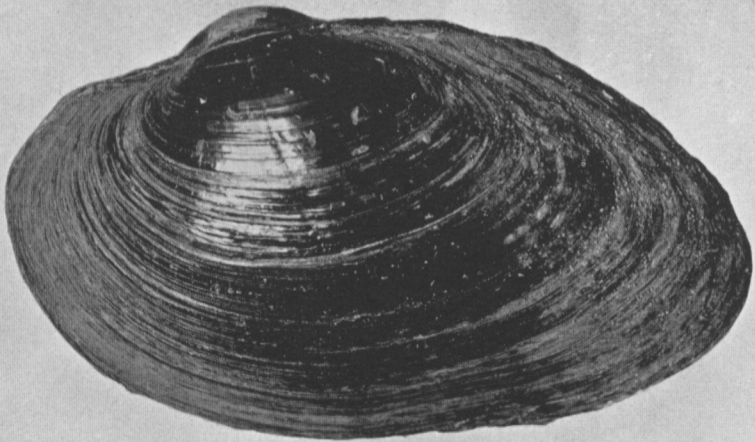


EXPLANATION OF PLATE II.

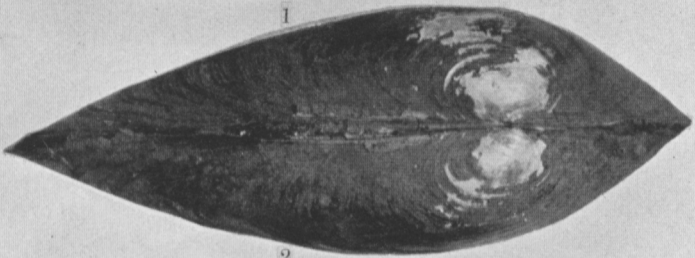
Figures 1, 2, 3. ANODONTA GRANDIS Say. ♂

Figures 4, 5. ANODONTA GRANDIS Say. Juvenile.

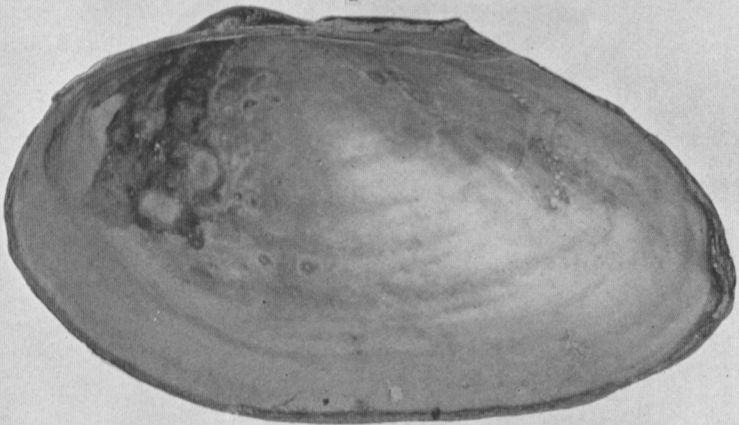
$\frac{3}{4}$  natural diameter.



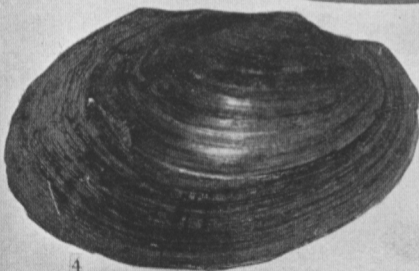
1



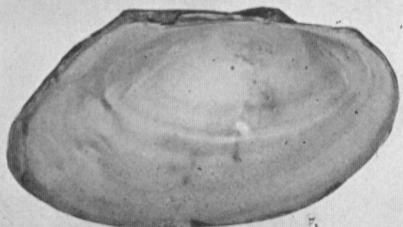
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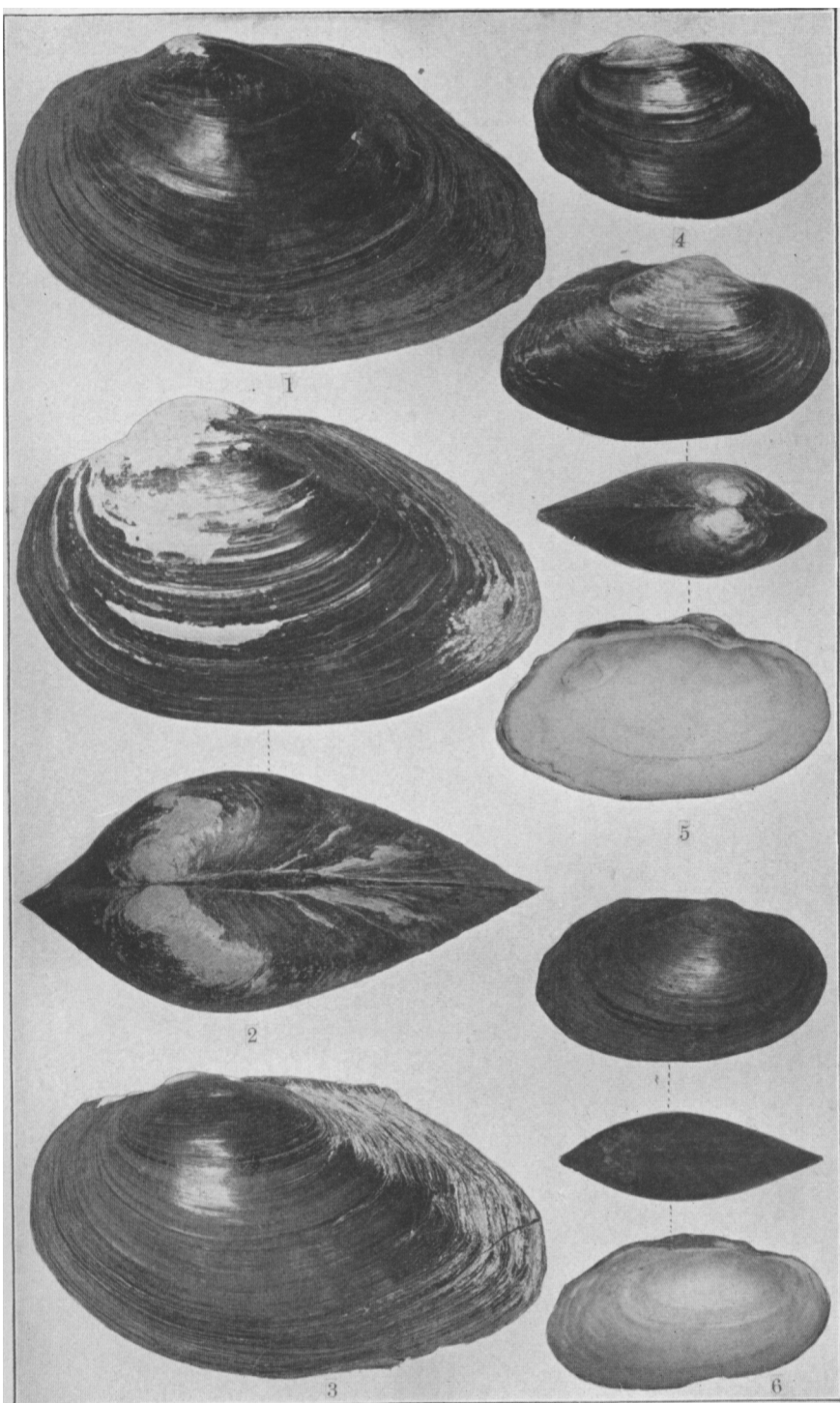


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### EXPLANATION OF PLATE III.

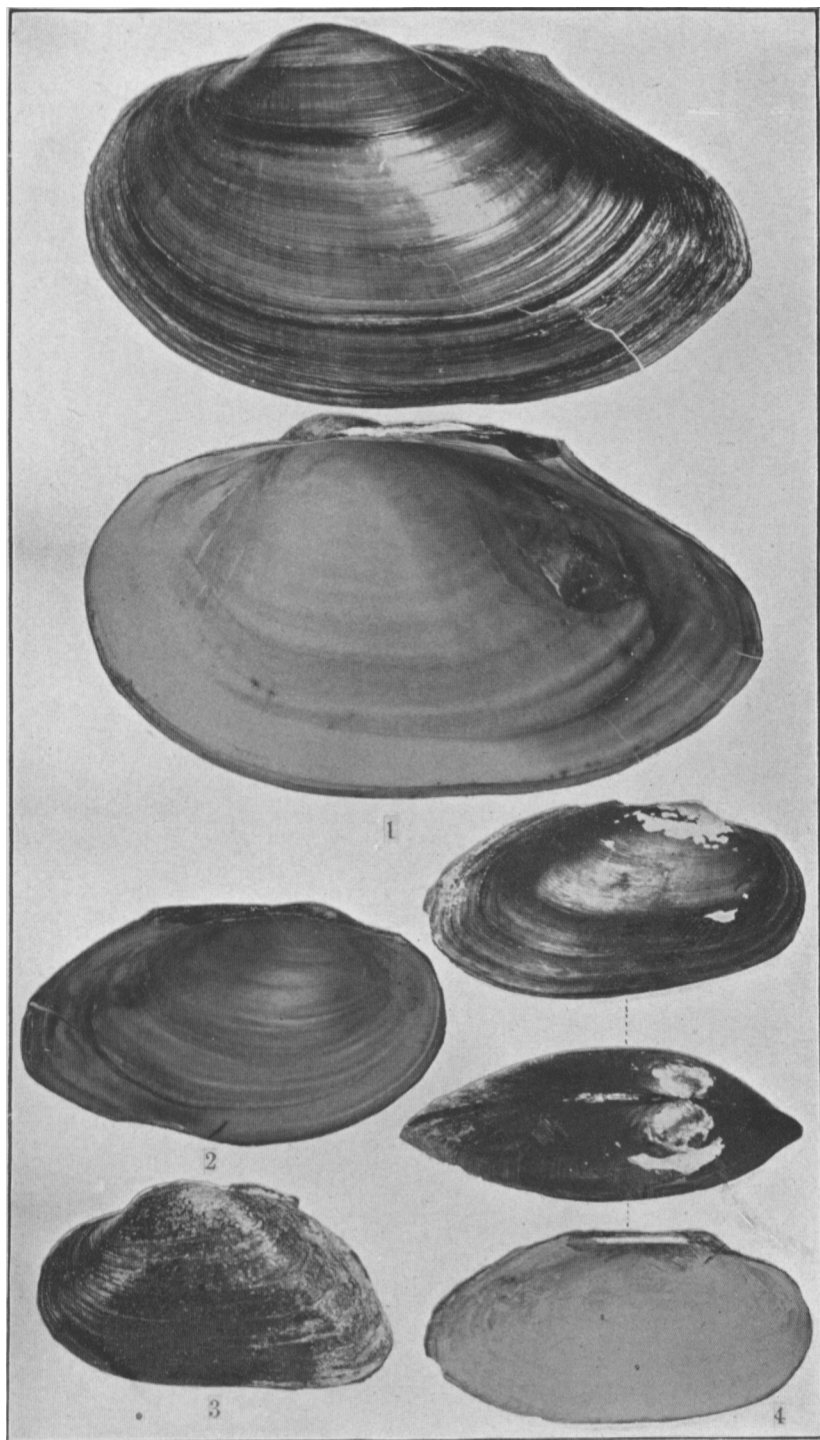
- Figure 1. ANODONTA GRANDIS Say. ♂
- " 2. ANODONTA FOOTIANA Lea. ♀
- " 3. ANODONTA FOOTIANA Lea. ♂
- " 4. ANODONTA FOOTIANA Lea. Juvenile.
- " 5. STROPHITUS PAVONIUS Lea.
- " 6. ANODONTOIDES FERUSSACIANUS Lea. Juvenile.

$\frac{3}{4}$  natural diameter.



# EXPLANATION OF PLATE IV.

- Figure 1. ANODONTA GRANDIS Say. ♀  
" 2. ANODONTA FOOTIANA Lea. ♂  
" 3. ALASMODONTA MARGINATA Say.  
" 4. ANODONTOIDES SUBCYLINDRACEUS Lea. ♀  
 $\frac{3}{4}$  natural diameter.





### EXPLANATION OF PLATE V.

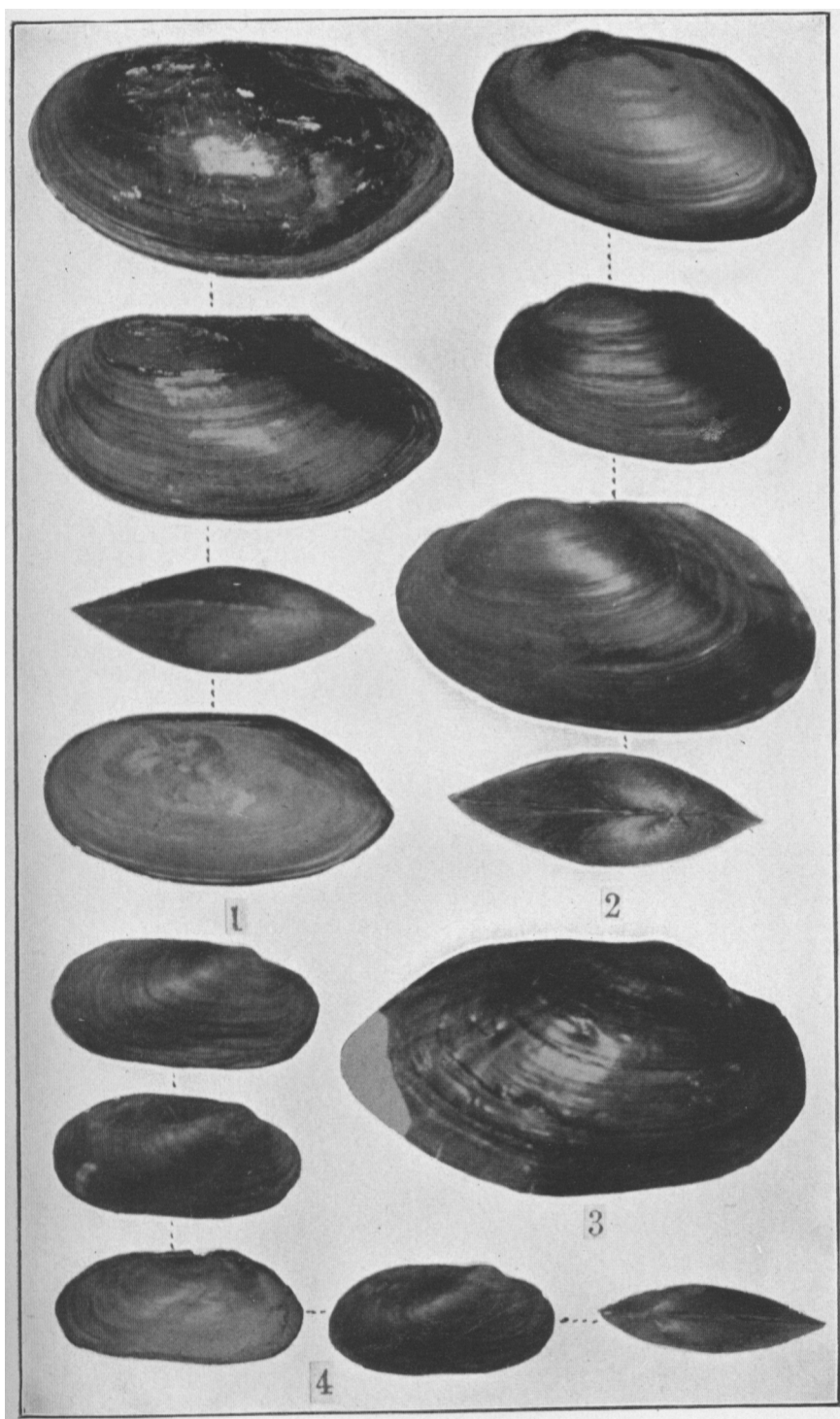
Figure 1. ANODONTA IMBECILIS Say. The upper figure is a female, the others are males

Figure 2. ANODONTOIDES FERUSSACIANUS Lea.

" 3. STROPHITUS PAVONIUS Lea.

" 4. UNIO HILDRETHIANUS Lea.

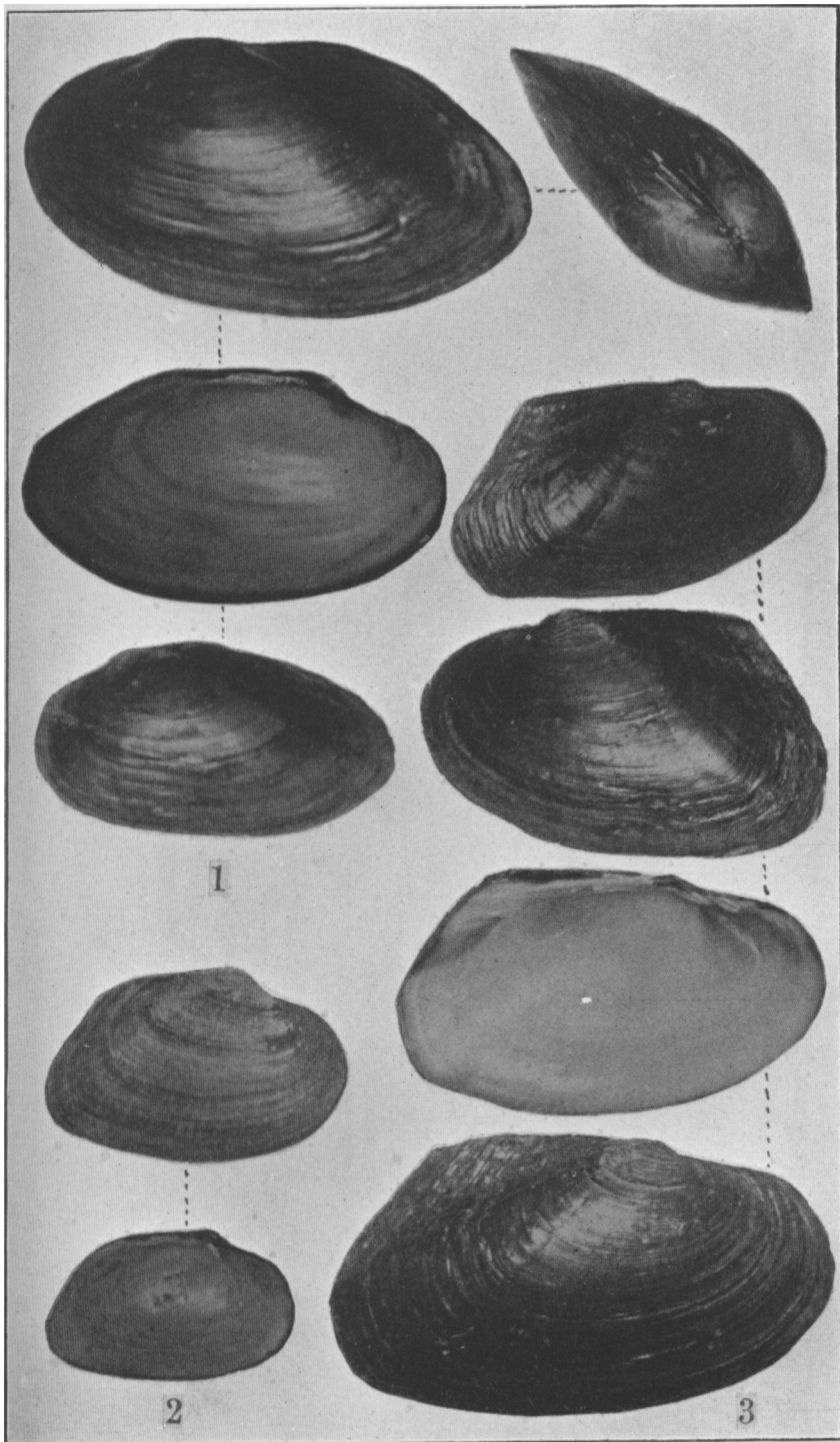
$\frac{4}{5}$  natural diameter.



## EXPLANATION OF PLATE VI.

- Figure 1. ANODONTOIDES SUBCYLINDRACEUS Lea. ♂  
" 2. ALASMODONTA CALCEOLA Lea (deltoideus Lea.)  
" 3. ALASMODONTA PRESSA Lea.

$\frac{4}{5}$  natural diameter.



### EXPLANATION OF PLATE VII.

Figure 1. ALASMODONTA RUGOSA Barnes.  $\frac{3}{4}$  natural diameter.

Figure 2. ALASMODONTA RUGOSA Barnes. Showing dark border on edge of interior.  $\frac{3}{4}$  natural diameter.

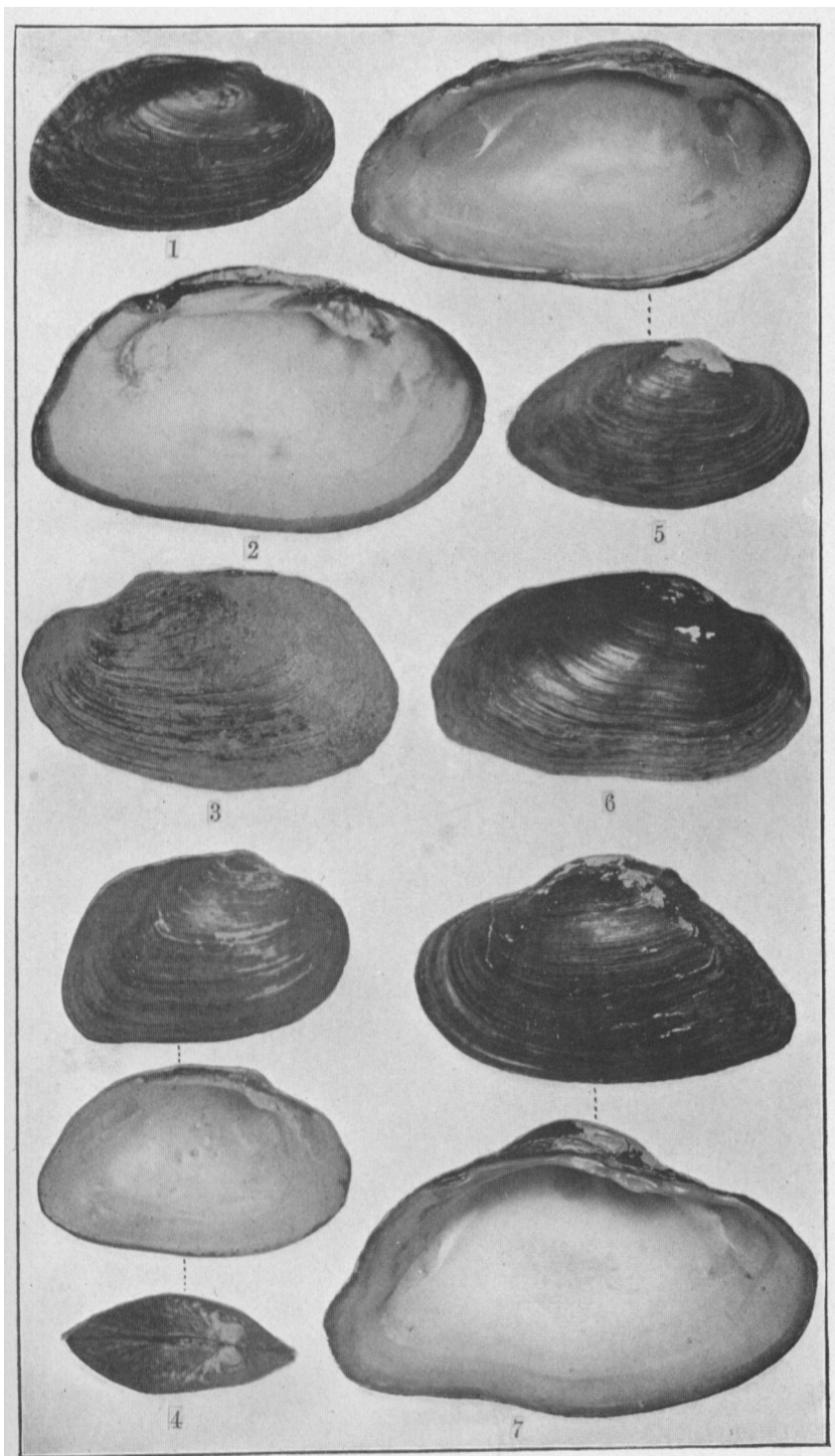
Figure 3. ALASMODONTA EDENTULA Lea. Natural size.

" 4. ALASMODONTA DELTOIDEA Lea.  $\frac{4}{5}$  natural diameter.

Figure 5. ALASMODONTA EDENTULA Lea. ♂  $\frac{3}{4}$  natural diameter.

Figure 6. ALASMODONTA EDENTULA Lea. ♀  $\frac{3}{4}$  natural diameter.

Figure 7. ALASMODONTA MARGINATA Say.  $\frac{3}{4}$  natural diameter.



## EXPLANATION OF PLATE VIII.

Figure 1. ALASMODONTA COMPLANATA Barnes.  $\frac{1}{2}$  natural diameter.

Figure 2. ALASMODONTA COMPLANATA Barnes. ♀  $\frac{1}{2}$  natural diameter.

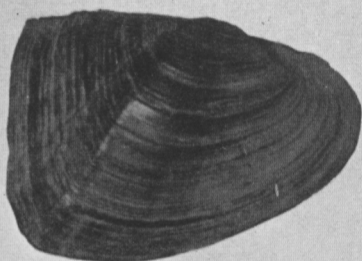
Figure 3. ALASMODONTA RUGOSA Barnes.  $\frac{3}{4}$  natural diameter.

Figure 4. ALASMODONTA RUGOSA Barnes.  $\frac{3}{4}$  natural diameter.

Figure 5. ANODONTA FOOTIANA Lea.  $\frac{2}{3}$  natural diameter.



1



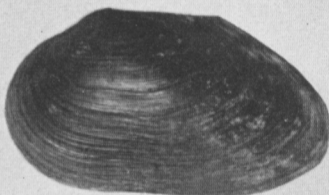
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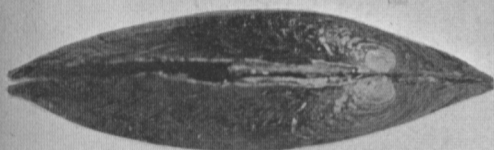
EXPLANATION OF PLATE IX.

ALASMODONTA COMPLANATA Barnes. 1, 2, 3, males. 4,  
Juvenile.

$\frac{3}{4}$  natural diameter.



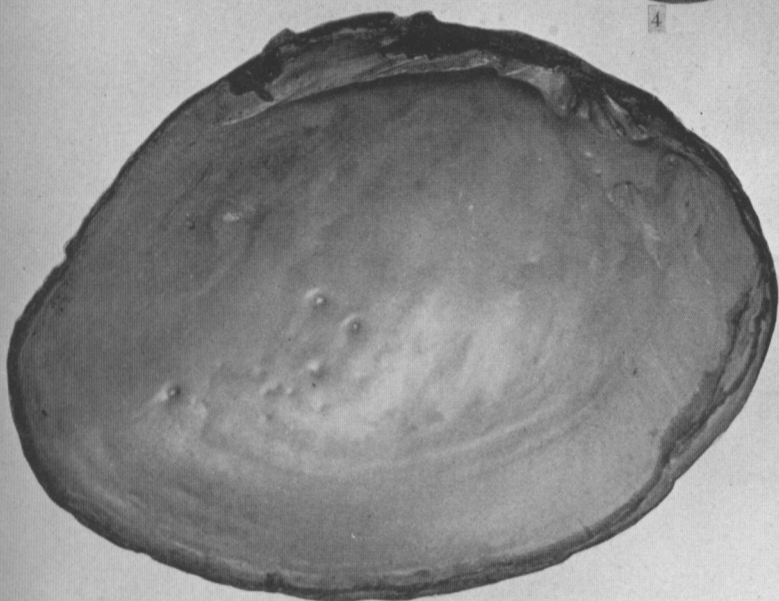
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2



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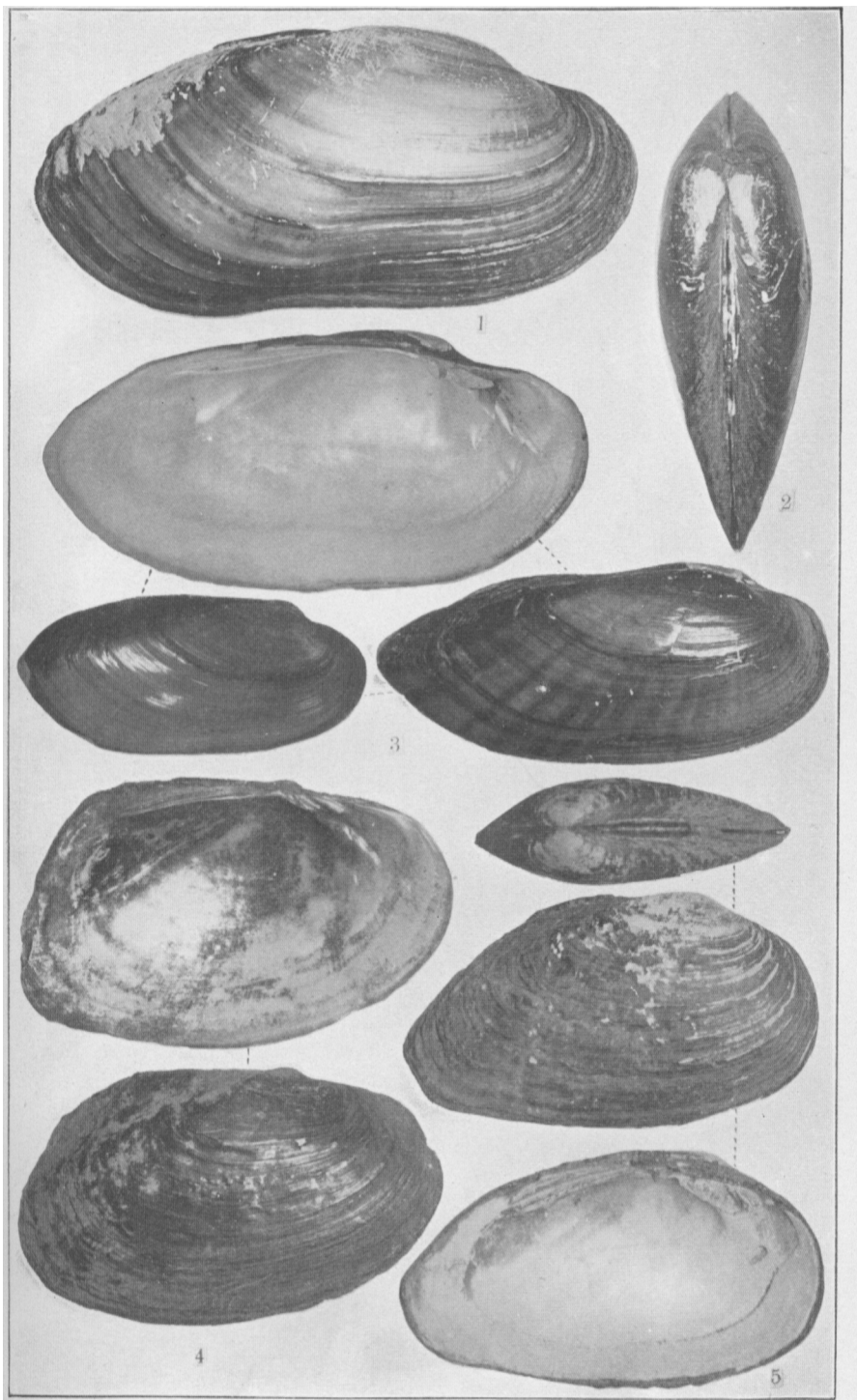


3

# EXPLANATION OF PLATE X.

- Figure 1. LAMPSILIS ANODONTOIDES Lea. ♀  
" 2. LAMPSILIS ANODONTOIDES Lea. ♂  
" 3. LAMPSILIS ANODONTOIDES Lea. ♂  
" 4. ALASMODONTA PRESSA Lea.  
" 5. LAMPSILIS SPATULATUS Lea.

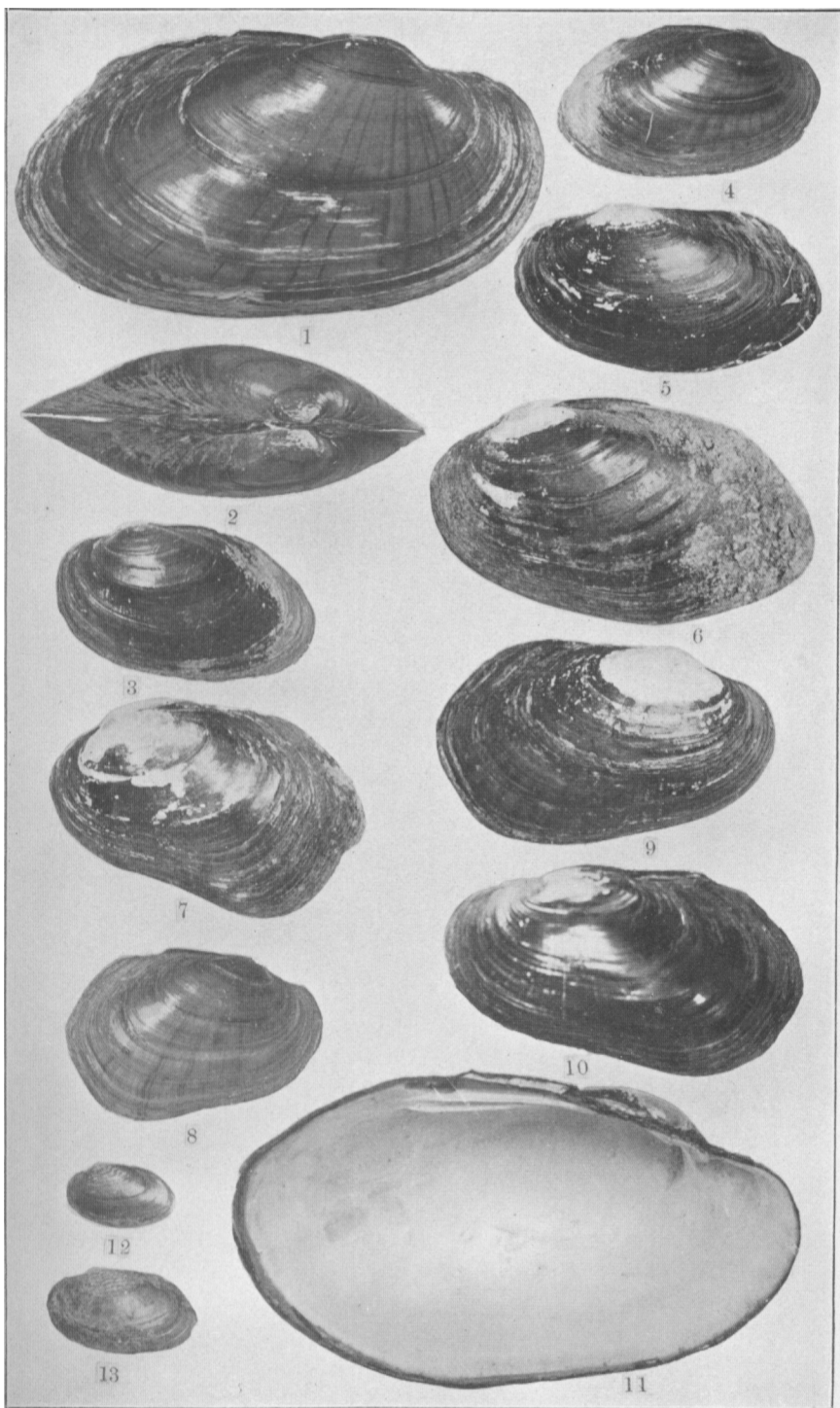
$\frac{3}{4}$  natural diameter.



# EXPLANATION OF PLATE XI.

- Figures 1, 2, 3, 4, 5, 6. LAMPSILIS LUTEOLUS Lam. ♂  
" 7, 8, 9, 10, 11. LAMPSILIS LUTEOLUS Lam. ♀  
" 12, 13. LAMPSILIS LUTEOLUS Lam. Juvenile.

$\frac{3}{4}$  natural diameter.



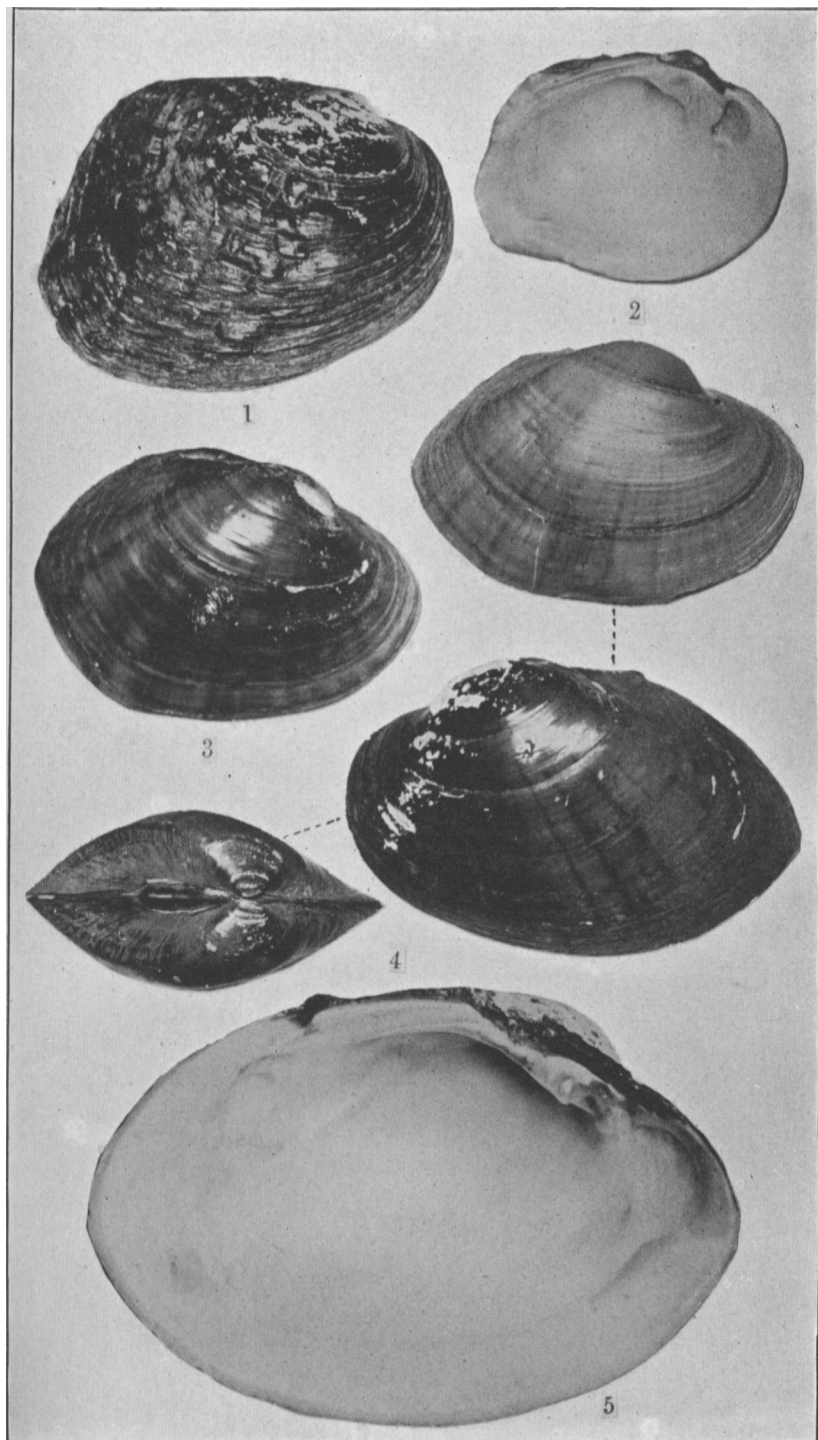
## EXPLANATION OF PLATE XII.

Figure 1. QUADRULA UNDULATA Barnes. Undulations almost obsolete.

Figure 2. QUADRULA LACHRYMOSA Lea.

- |   |                                  |   |
|---|----------------------------------|---|
| " | 3. LAMPSILIS VENTRICOSUS Barnes. | ♀ |
| " | 4. LAMPSILIS VENTRICOSUS Barnes. | ♂ |
| " | 5. LAMPSILIS VENTRICOSUS Barnes. | ♂ |

$\frac{2}{3}$  natural diameter.





## EXPLANATION OF PLATE XIII.

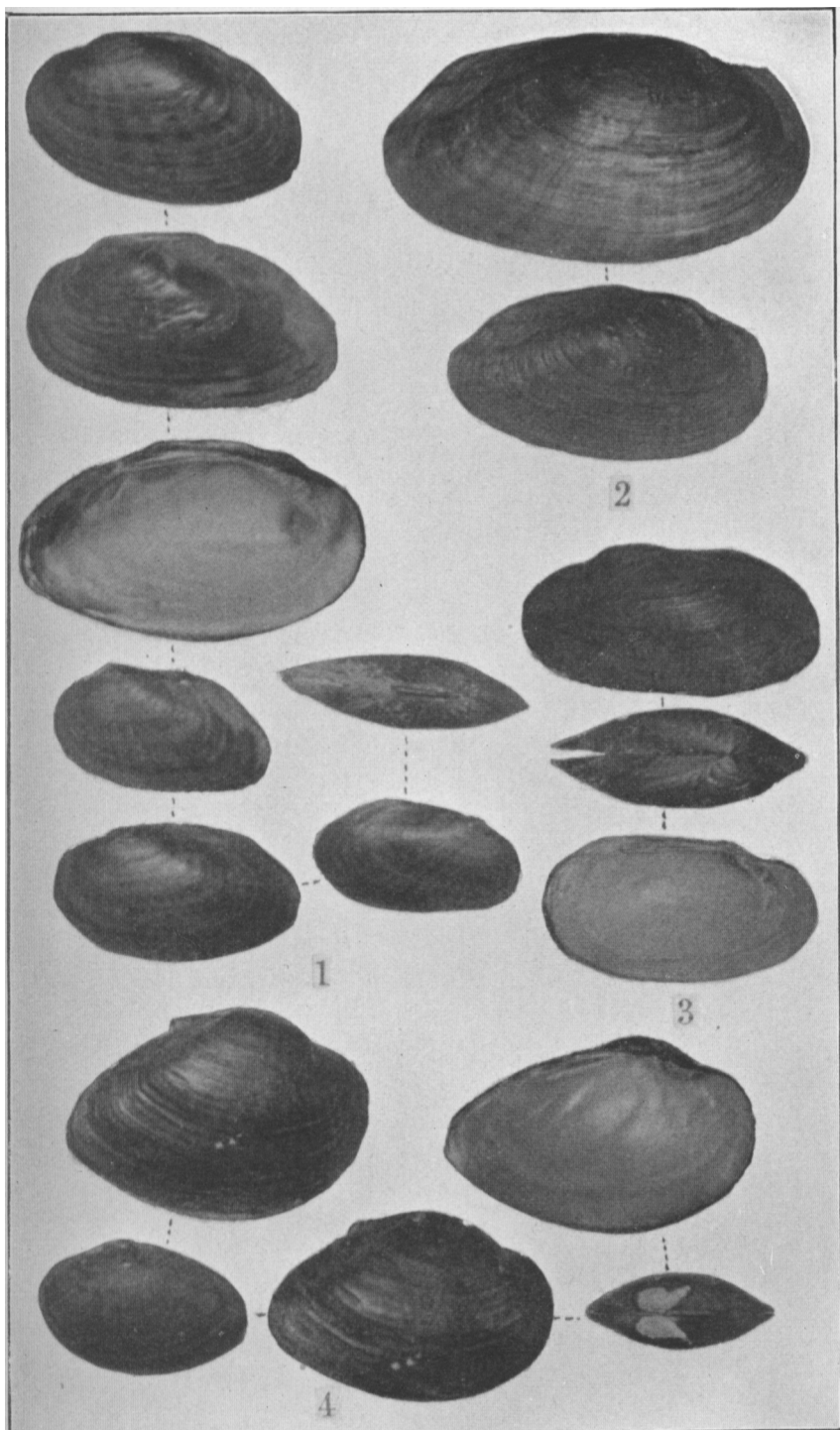
Figure 1. LAMPSILIS IRIS Lea.

" 2. LAMPSILIS SPATULATUS Lea.

" 3. LAMPSILIS PARVUS Barnes.

" 4. PLAGIOLA DONACIFORMIS Lea.

$\frac{3}{4}$  natural diameter.



## EXPLANATION OF PLATE XIV.

Figure 1. QUADRULA COCCINEA Lea.

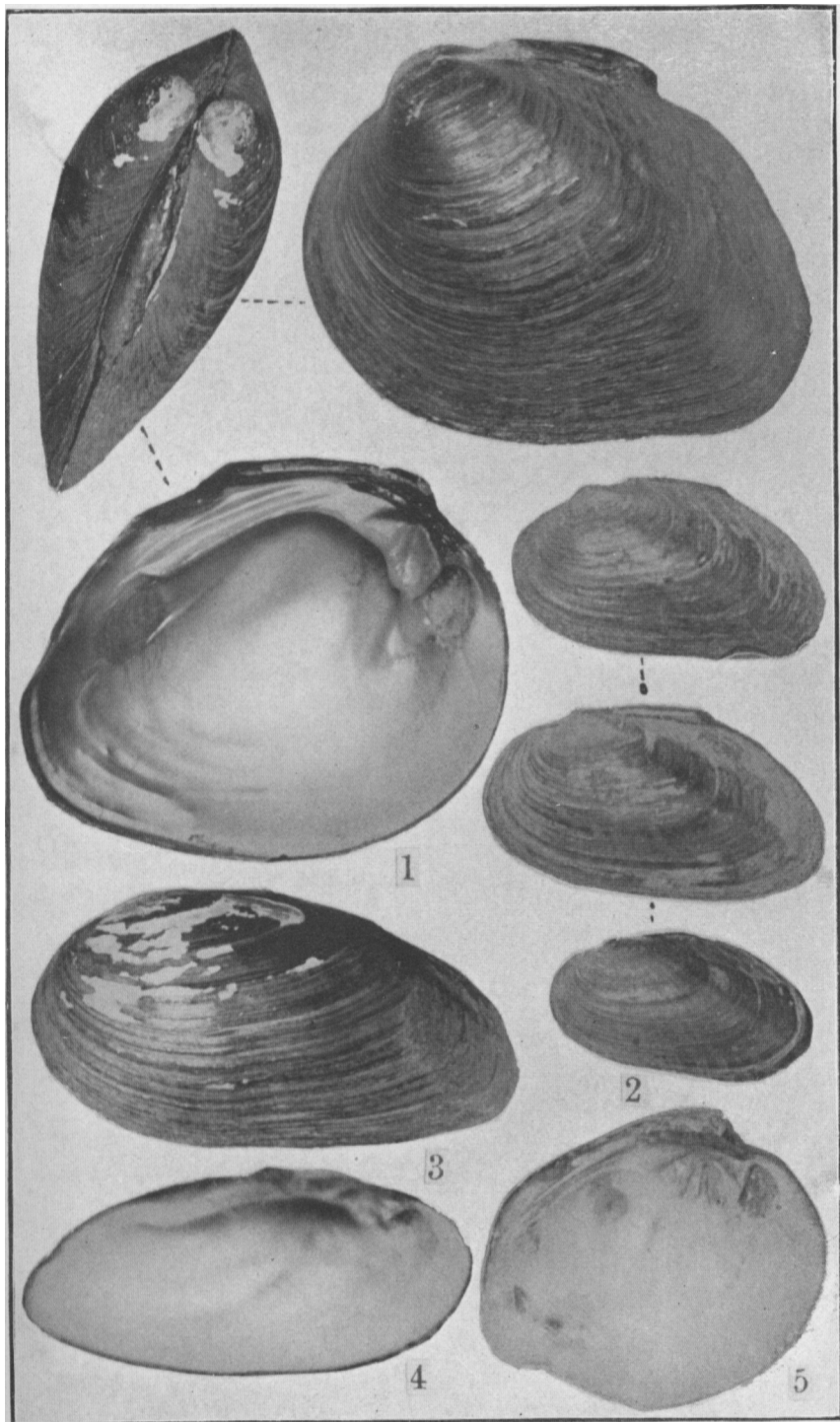
" 2. LAMPSILIS IRIS Lea.

" 3. UNIO GIBBOSUS Barnes. ♀

" 4. UNIO GIBBOSUS Barnes. ♂

" 5. OBLIQUARIA REFLEXA Rafinesque

$\frac{3}{4}$  natural diameter.



## EXPLANATION OF PLATE XV.

Figure 1. UNIO GIBBOSUS Barnes. ♂ **Juvenile.**

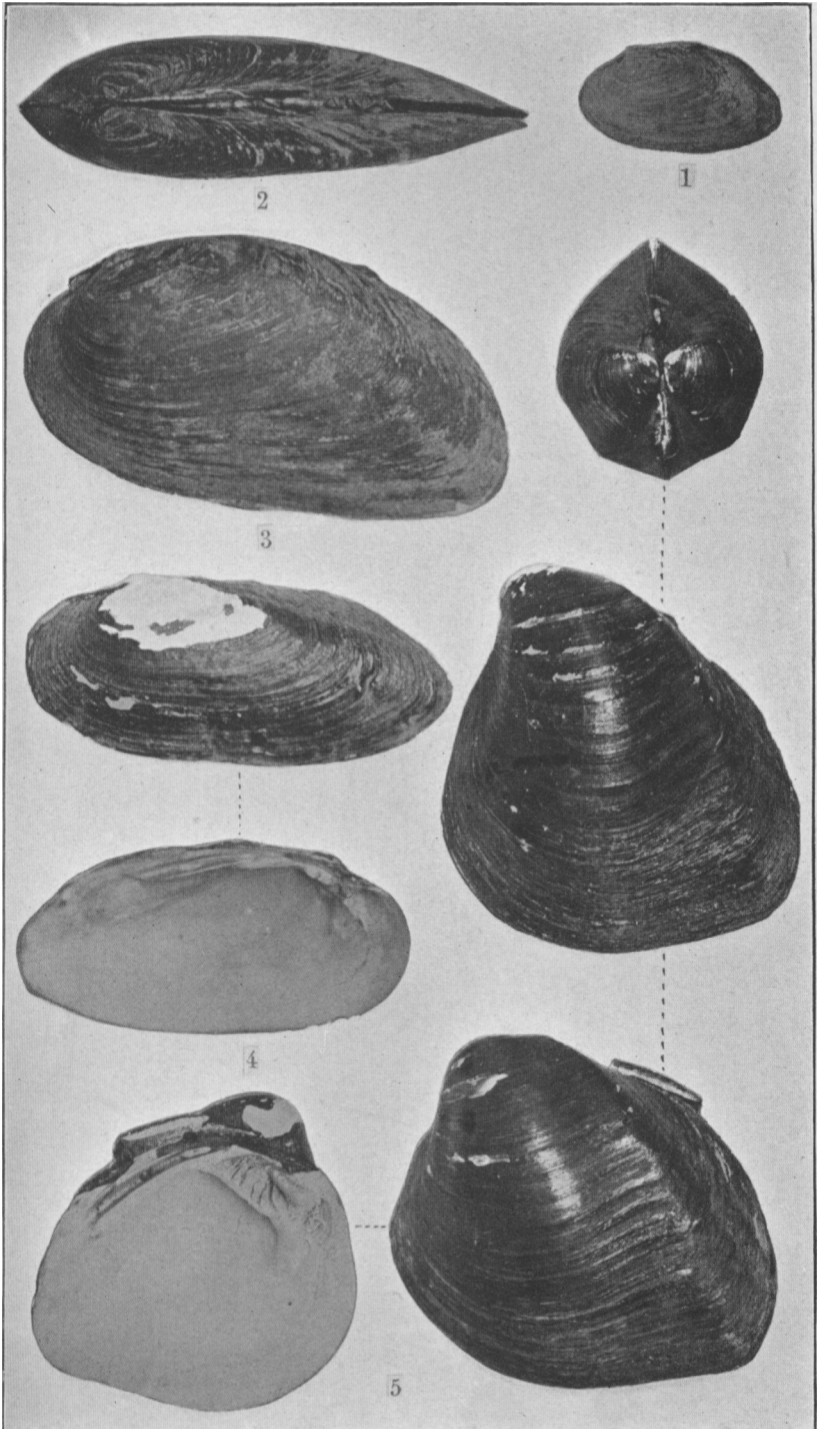
" 2. UNIO GIBBOSUS Barnes. ♂

" 3. UNIO GIBBOSUS Barnes. ♀

" 4. UNIO GIBBOSUS Barnes. ♂

" 5. QUADRULA TRIGONA Lea.

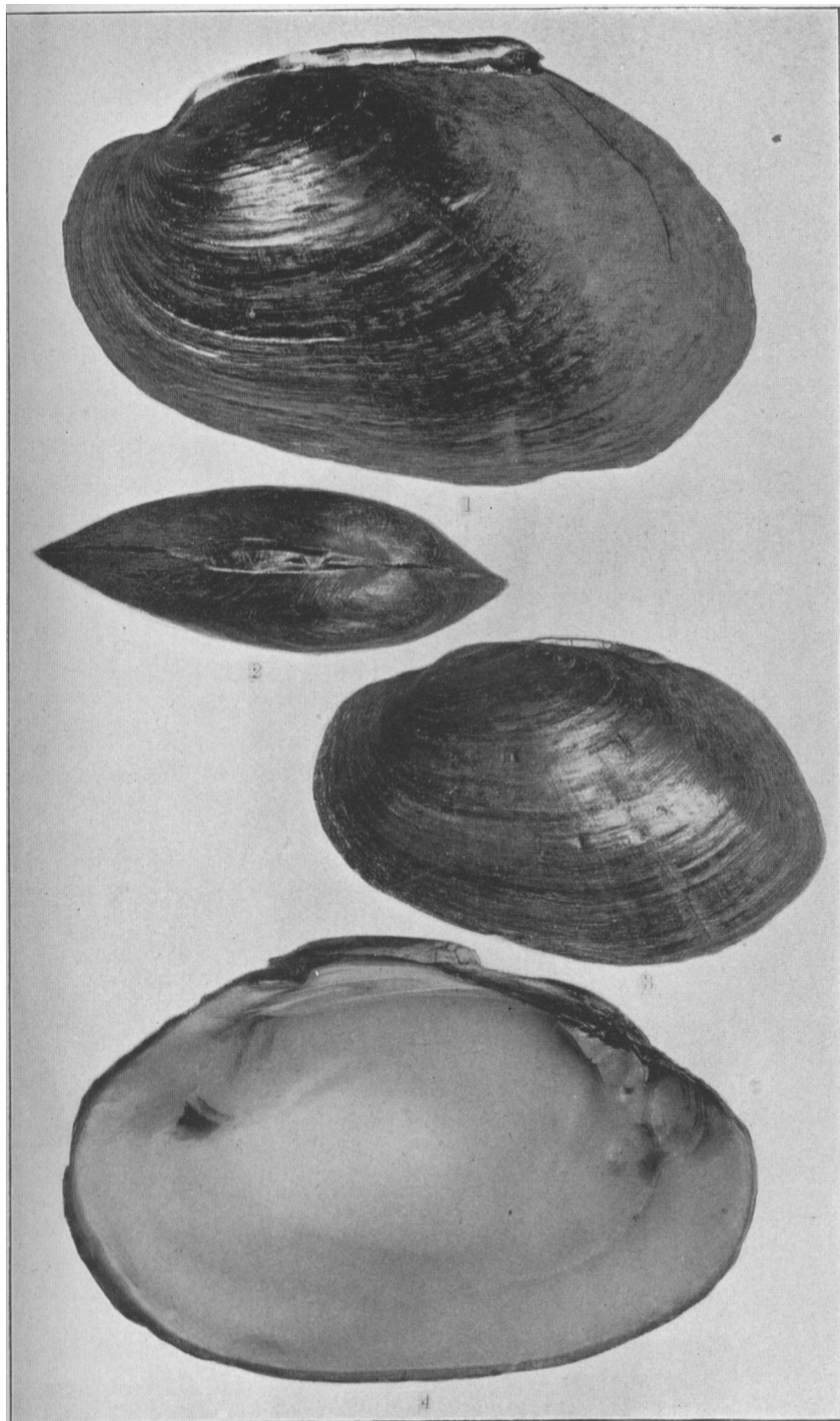
$\frac{3}{4}$  natural diameter.



EXPLANATION OF PLATE XVI.

Figures 1, 2, 3, 4. LAMPSILIS LIGAMENTINUS Lam.

$\frac{3}{4}$  natural diameter.





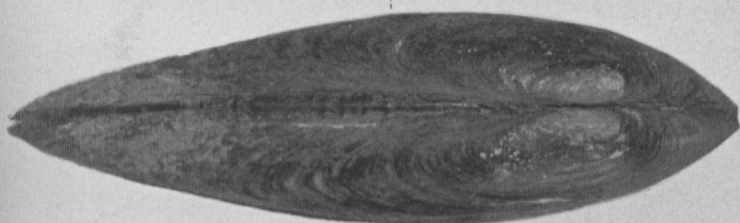
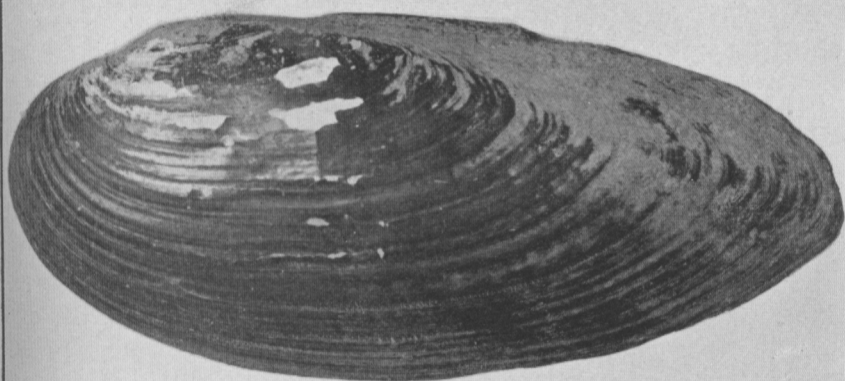
EXPLANATION OF PLATE XVII.

Figure 1. LAMPSILIS RECTUS Lamarck. ♂

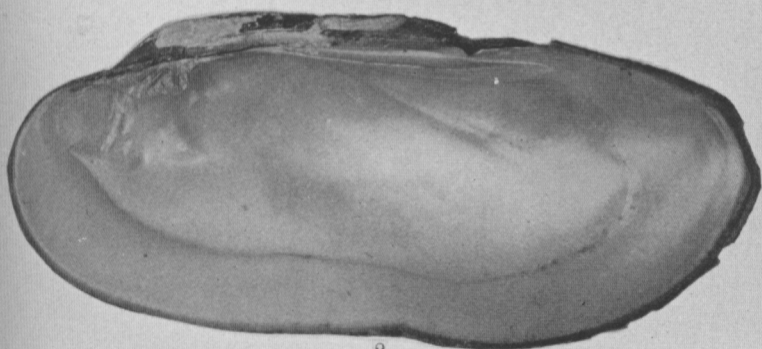
" 2. LAMPSILIS RECTUS Lamarck. ♀

" 3. STROPHITUS EDENTULUS Say.

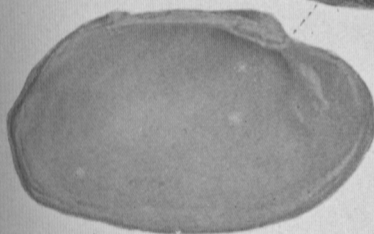
$\frac{3}{4}$  natural diameter.



1



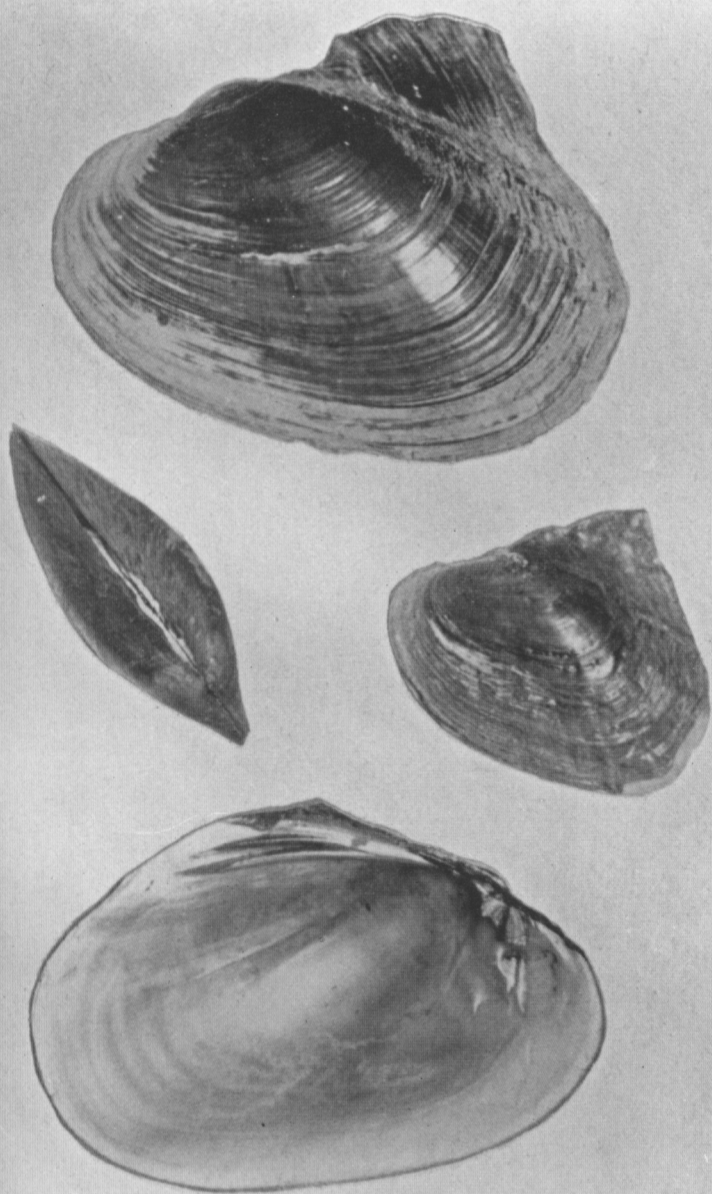
2



3

EXPLANATION OF PLATE XVIII.

LAMPSILIS ALATUS Say.  $\frac{1}{2}$  natural diameter.



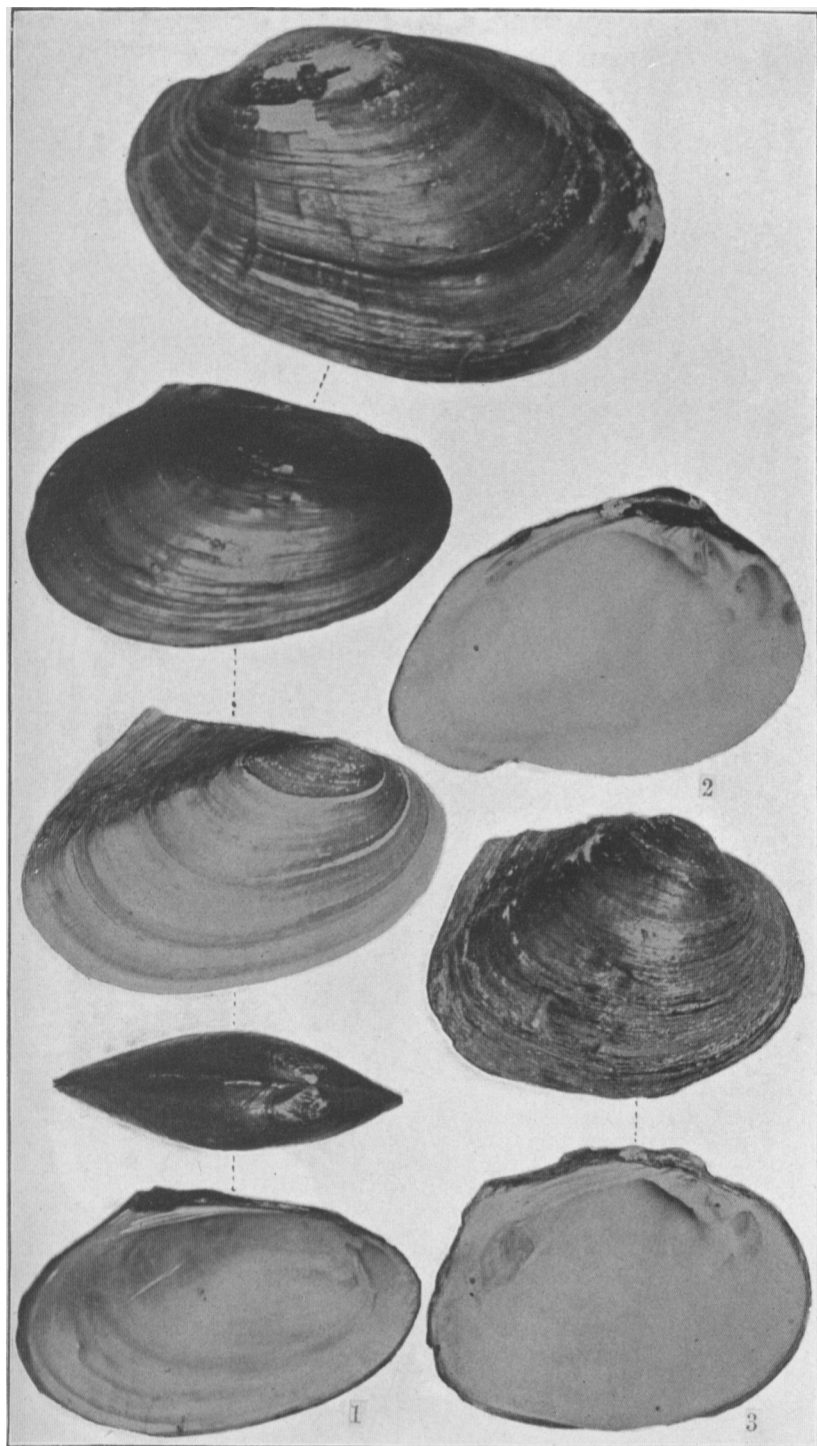
## EXPLANATION OF PLATE XIX.

Figure 1. *LAMPSILIS GRACILIS* Barnes.

" 2. *QUADRULA RUBIGINOSA* Lea.

" 3. *QUADRULA COCCINA* Lea.

$\frac{3}{4}$  natural diameter.

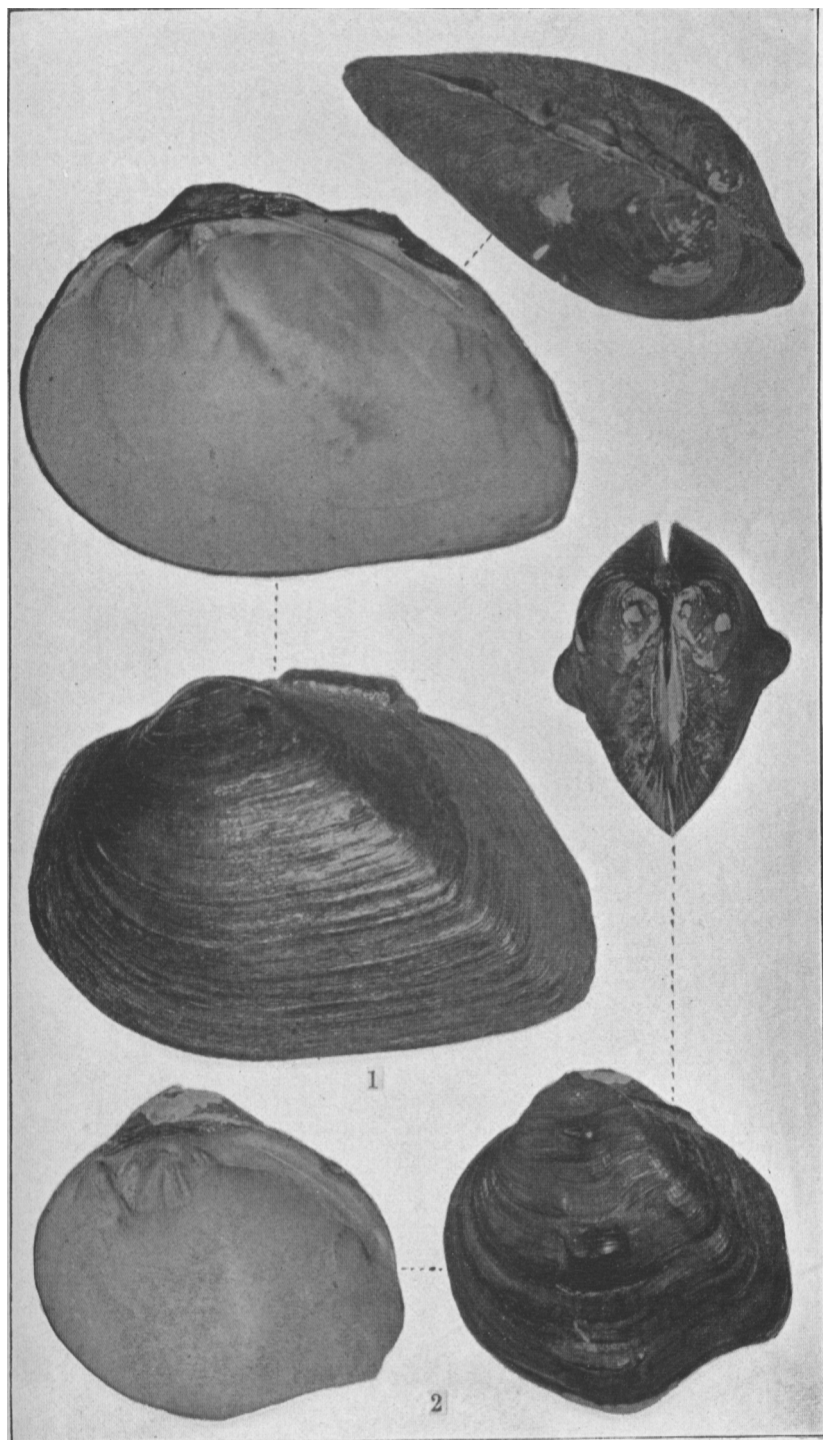


EXPLANATION OF PLATE XX.

Figure 1. QUADRULA RUBIGINOSA Lea.

" 2. OBLIQUARIA CORNUTA Barnes.

$\frac{3}{4}$  natural diameter.





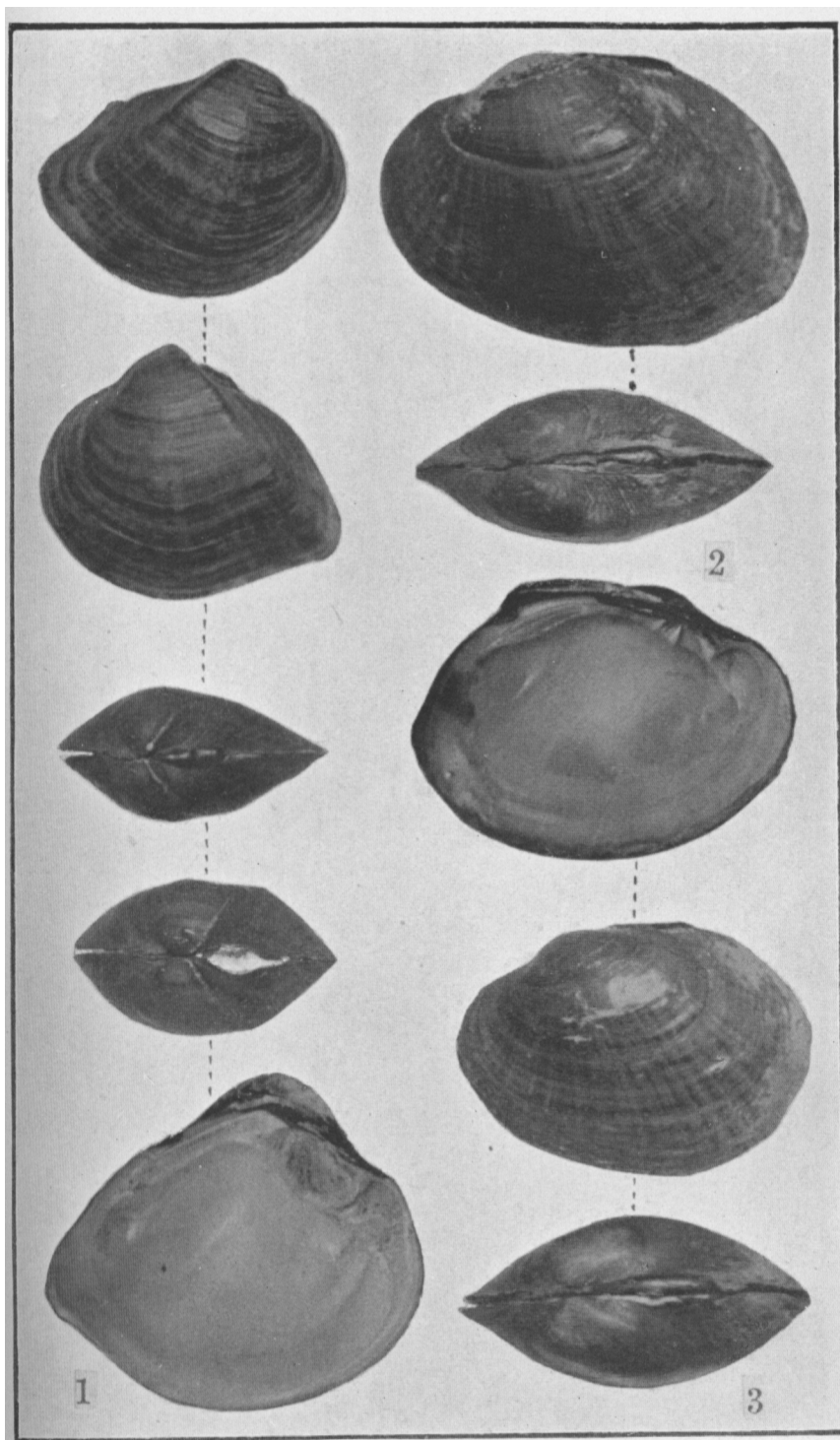
## EXPLANATION OF PLATE XXI.

Figure 1. *PLAGIOLA ELEGANS* Lea.

" 2. *LAMPSILIS MULTIRADIATUS* Lea. ♂

" 3. *LAMPSILIS MULTIRADIATUS* Lea. ♀

$\frac{3}{4}$  natural diameter.



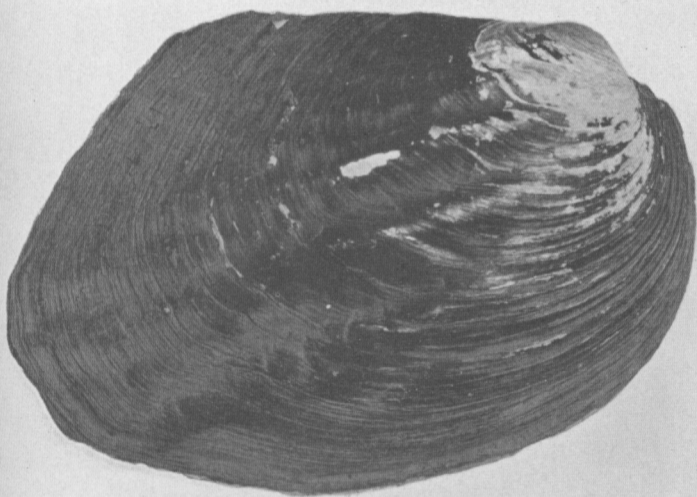
## EXPLANATION OF PLATE XXII.

Figure 1. *QUADRULA UNDULATA* Barnes. Juvenile.

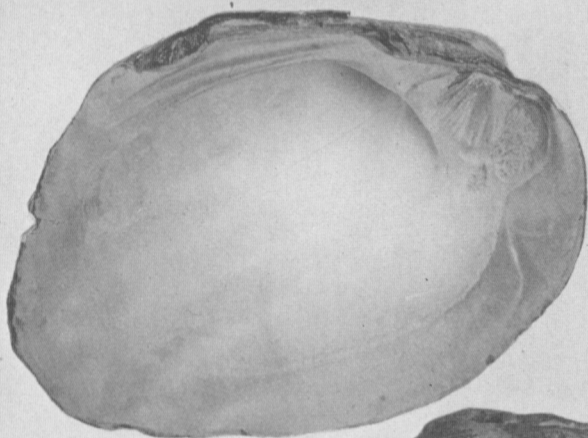
" 2. *QUADRULA UNDULATA* Barnes.

" 3. *ALASMODONTA MARGINATA* Say.

$\frac{3}{4}$  natural diameter.



1



2

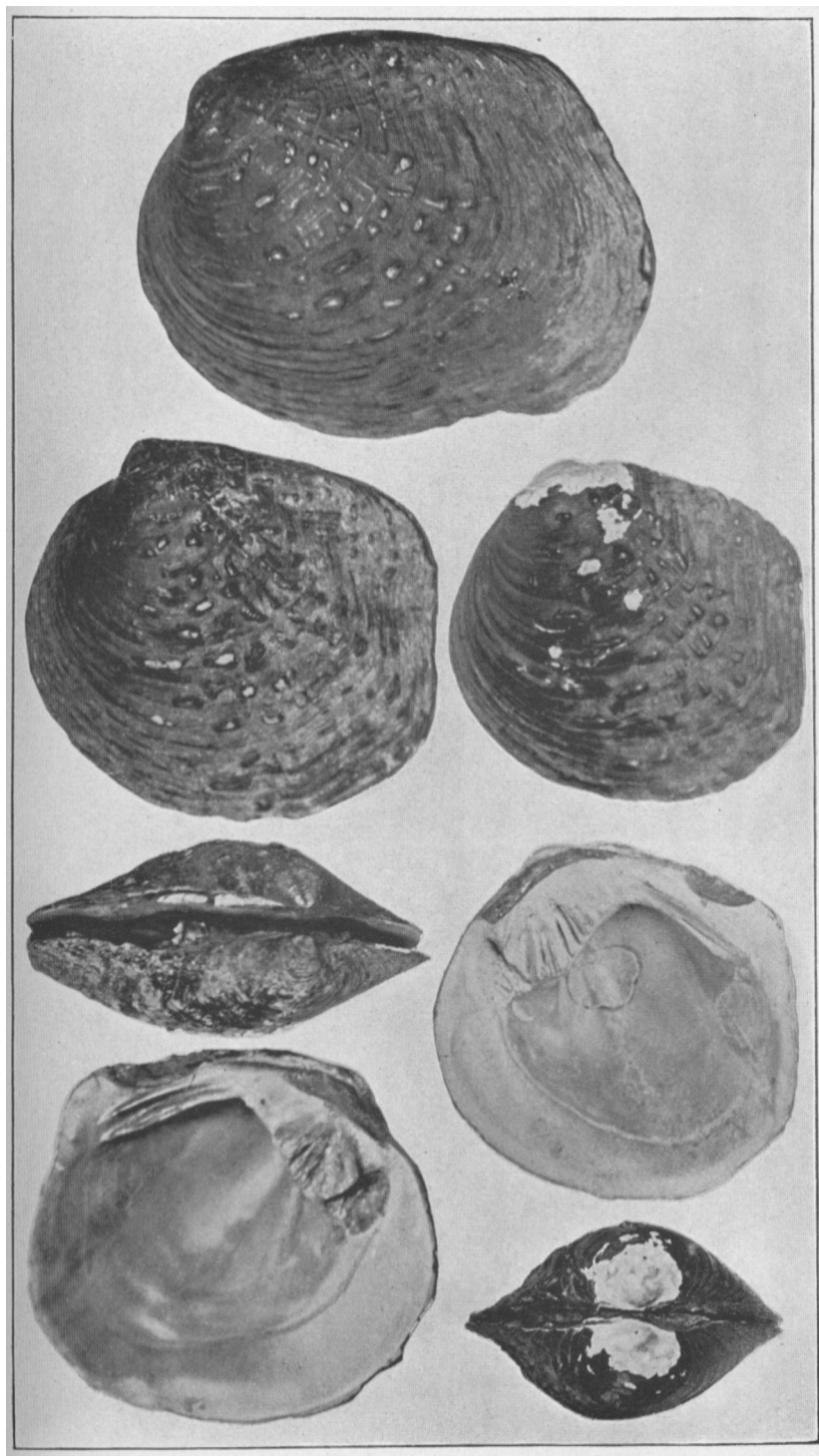


3

EXPLANATION OF PLATE XXIII.

QUADRULA VERRUCOSA Barnes.

$\frac{3}{4}$  natural diameter.

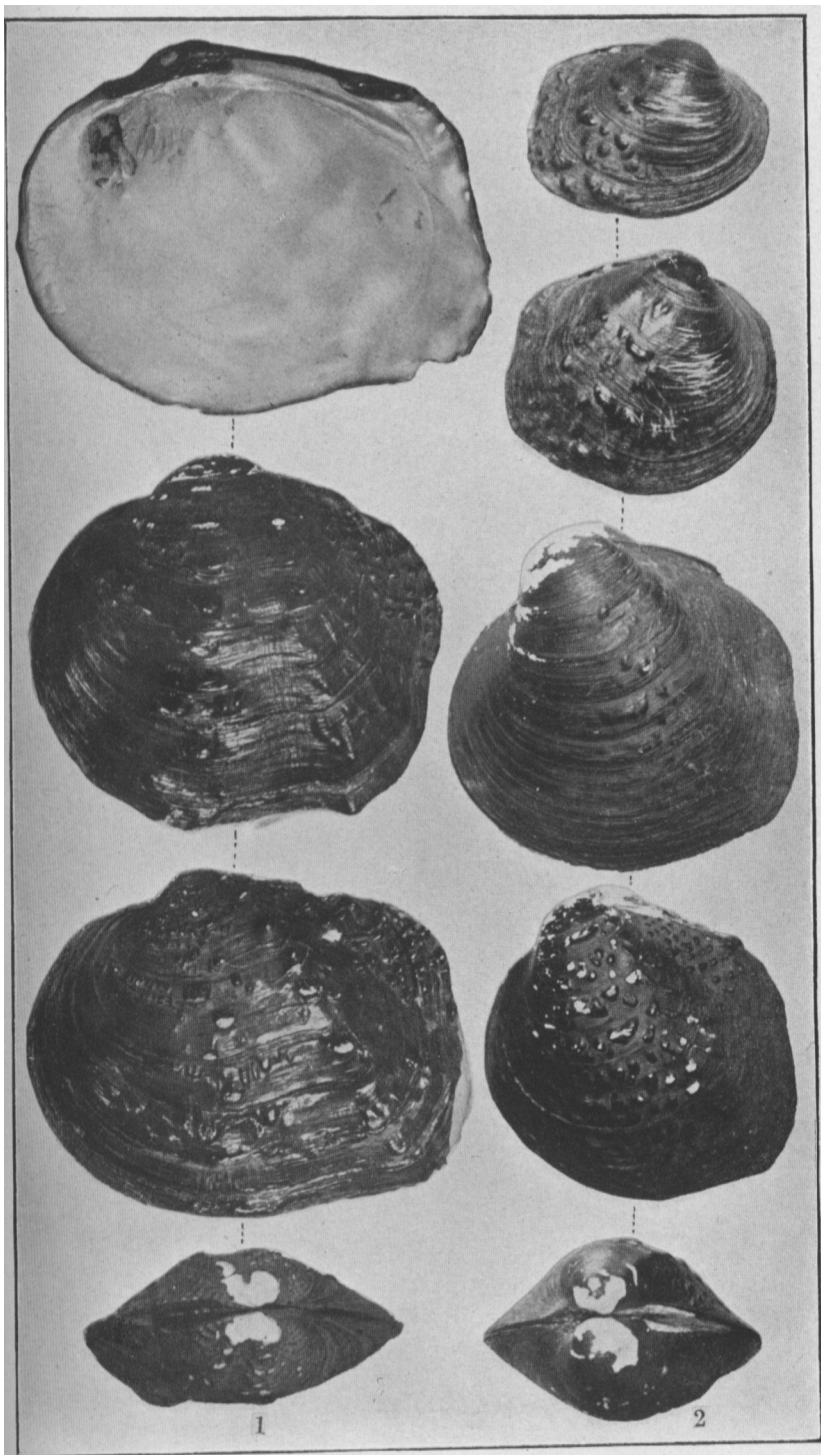


EXPLANATION OF PLATE XXIV.

Figure 1. *QUADRULA LACHRYMOSA* Lea.

" 2. *QUADRULA PUSTULOSA* Lea. Showing pustulose variation.

$\frac{3}{4}$ natural diameter.

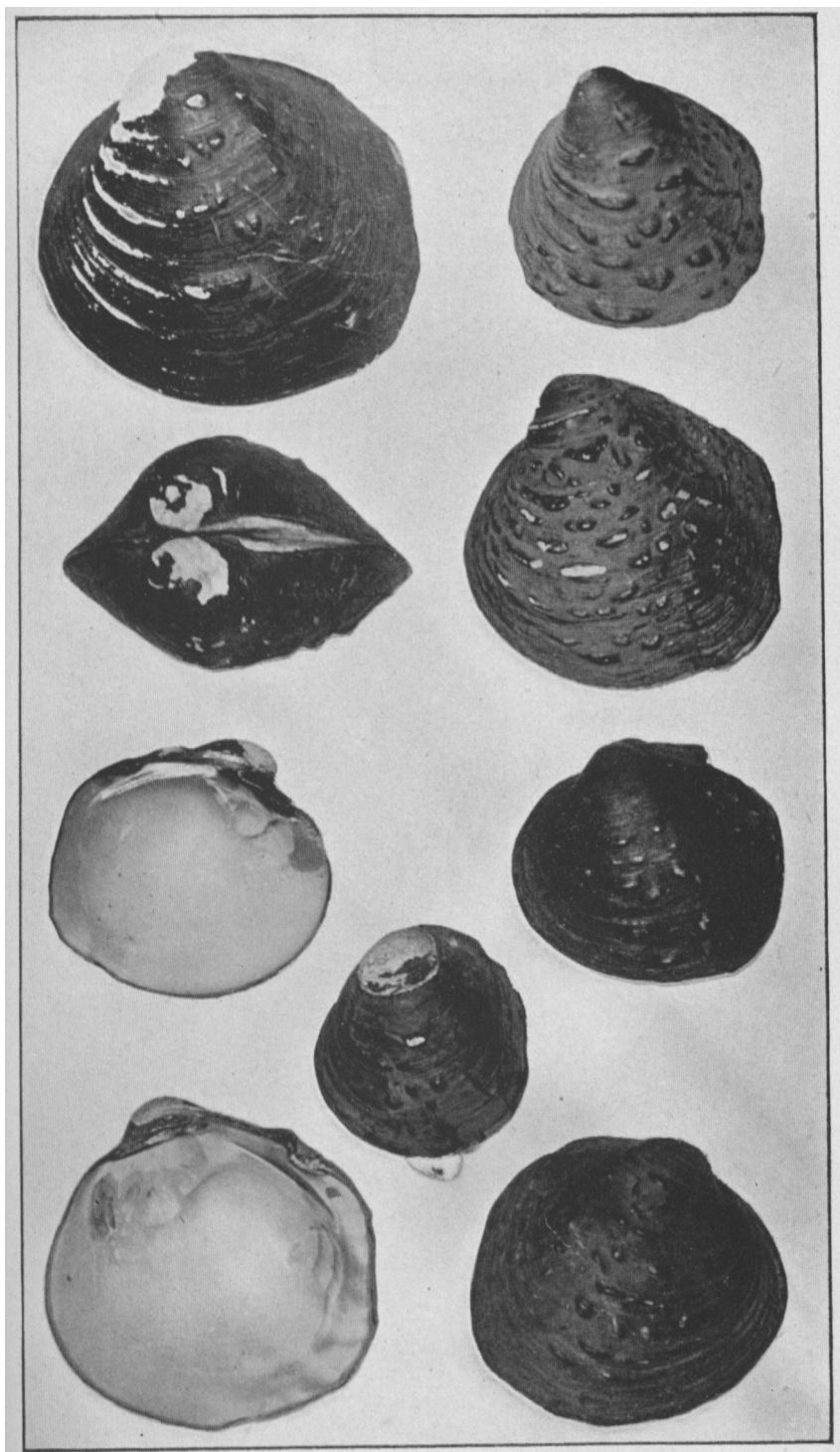




EXPLANATION OF PLATE XXV.

QUADRULA PUSTULOSA Lea. Showing pustulose variation.

$\frac{3}{4}$  natural diameter.



## EXPLANATION OF PLATE XXVI.

Figure 1. *QUADRULA PLICATA* Le Sueuer.  $\frac{3}{4}$  natural diameter.

Figure 2. *SOMATOGYRUS INTEGER* Say. Enlarged.

" 3. *CARYCHIUM EXIGUUM* Say. Enlarged.

" 4. *CARYCHIUM EXILE* H. C. Lea. Enlarged.

" 5. *PLANORBIS EXACUTUS* Say. Enlarged.

" 6. *PLANORBIS DEFLECTUS* Say. Enlarged.

" 7. *PLANORBIS PARVUS* Say. Enlarged,

" 8. *POMATIOPSIS CINCINNATIENSIS* Anth. ♂ Enlarged.

" 9. *POMATIOPSIS CINCINNATIENSIS* Anth. ♀ Enlarged.

" 10. *CINCINNATIA OBTUSA* Lea. Enlarged.

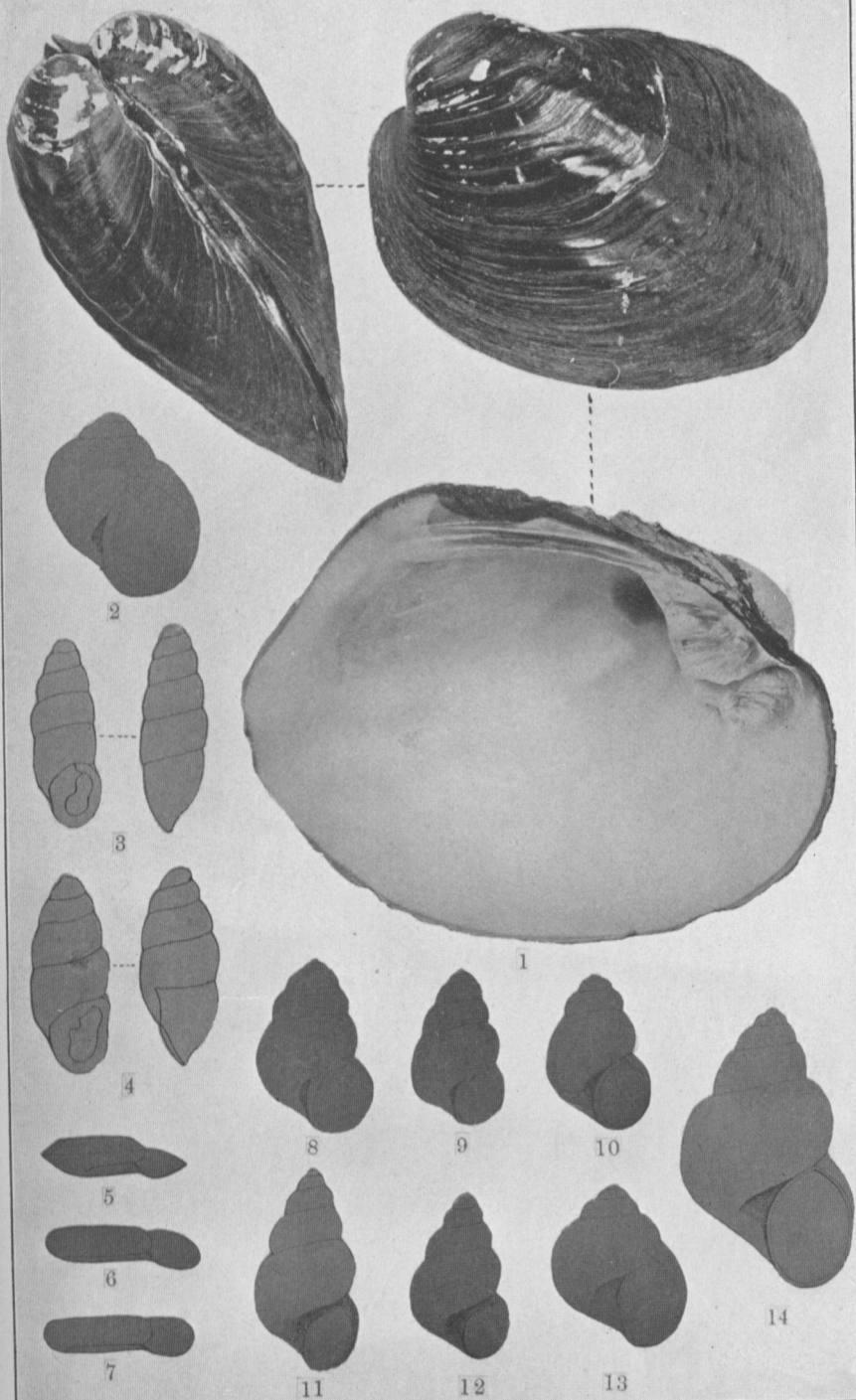
" 11. *BYTHINELLA NICKLINIANA* Lea. Enlarged.

" 12. *AMNICOLA LUSTRICA* Pilsbry. Enlarged.

" 13. *AMNICOLA LIMOSA* Say. Enlarged.

" 14. *CINCINNATIA CINCINNATIENSIS* Lea. Enlarged.

Numbers 2 to 14 are photographs of camera lucida drawings, by the author.



## EXPLANATION OF PLATE XXVII.

Figure 1. SPHÆRIUM STAMINEUM Conrad.

" 2. SPHÆRIUM STRIATINUM Lamarck.

" 3. SPHÆRIUM SIMILE Say.

" 4. SPHÆRIUM SOLIDULUM Prime.

" 5. CALYCULINA TRANSVERSA Say.

" 6. CALYCULINA PARTUMEIA Say.

" 7. SPHÆRIUM FABALE Prime.

" 8. CALYCULINA TRUNCATUM Sinsley.

" 9. CALYCULINA SECURIS Prime.

" 10. SPHÆRIUM OCCIDENTALE Prime.

" 11. ALASMODONTA COMPLANATA Barnes. Juvenile.

" 12. ANODONTA GRANDIS Say. Juvenile.

" 13. QUADRULA PUSTULOSA Lea. Juvenile.

Natural diameter.

